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Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants
III. Coldwater Creek Drainage Basin St. Louis, Missouri

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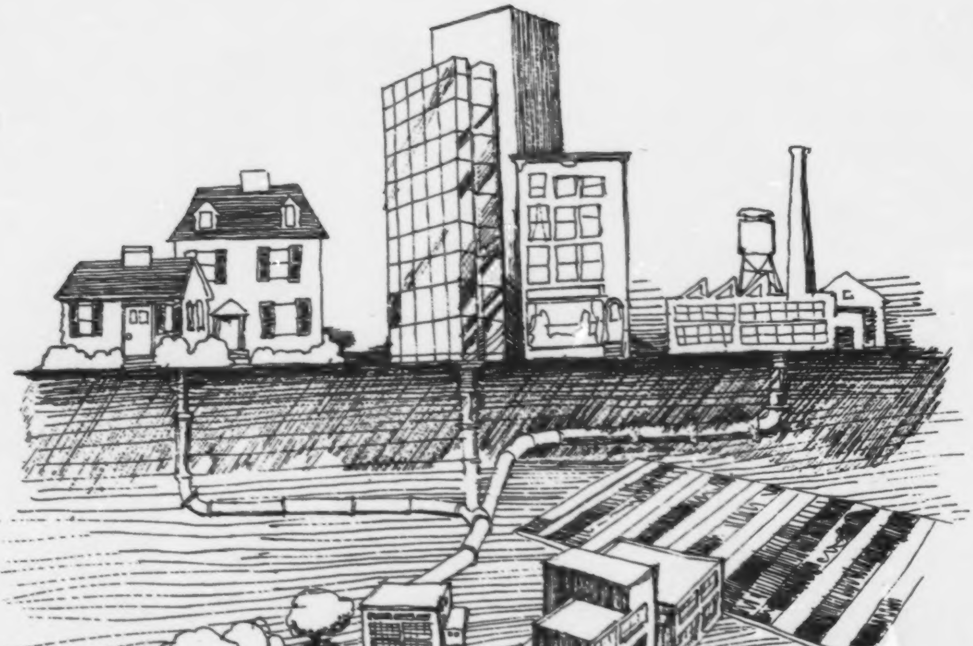

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16. ABSTRACT This report represents the second in a series of studies of sewage treatment basins undertaken in order to determine the relative importance of major sources of pollutants found at the influent of publicly-owned treatments works (POTWs). The general categories of residential, commercial and industrial have been identified as appropriate classifications for this study.

This second study was carried out in the drainage basin of the Coldwater Creek treatment plant in the metropolitan St. Louis, Missouri area. In contrast to the predominantly residential character of the Muddy Creek basin in Cincinnati, the Coldwater Creek basin area had a reasonable amount of flow from commercial and industrial sources in addition to the residential flow. The relative flow from these source types in the basin was: Residential: 78%, Commercial: 10%, Industrial: 12%.

The quality control program initiated in the Cincinnati study was retained for this city. A total of 64 samples, including field blanks, were collected for analysis. Samples were analyzed for all priority pollutants (excluding asbestos) plus manganese, the classical parameters of ammonia, TSS, TOC, BOD, COD, oil and grease, as well as pH and temperature.

A total of 47 pollutants, 32 organic priority pollutants, 12 priority pollutant-metals plus manganese, total cyanides and total phenols were observed in St. Louis, plus the six classical parameters which were measured. Seventy-nine (79) of the

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At the Coldwater Creek Water Treatment Plant, samples of the effluent as well as the influent were obtained, enabling an evaluation of the removal efficiencies to be made. The average removal efficiency for the organics was 89%; some of the trihalomethanes displayed removal efficiencies around 65%, and benzene was removed at only 48%. Most of the metals were removed with efficiencies around 70%. However, manganese, nickel and zinc had removal efficiencies of 30%, and selenium exhibited an increase in mass load across the treatment plant. With the exception of ammonia (12%), the removal efficiencies for total cyanides, total phenols, and the classicals were all quite high.

SOURCES OF TOXIC POLLUTANTS FOUND IN INFLUENTS TO SEWAGE TREATMENT PLANTS

III. COLDWATER CREEK DRAINAGE BASIN, ST. LOUIS, MISSOURI

Final Report On
Task Order No. 10
EPA Contract No. 68-01-3857

by
P. Levins, J. Adams, P. Brenner, S. Coons, K. Thrun, J. Varone

Prepared For
U.S. Environmental Protection Agency
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Washington, D.C.

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The cooperation of the personnel of the Metropolitan St. Louis Sewer District was invaluable in designing the field plan and obtaining the other supporting data for this study. We wish to thank Mr. Bernard Rains, Mr. Patrick Karney, Mr. Edward Kelemen, and their respective staffs for their efforts. The personnel of the East-West Coordinating Council and the St. Louis County Planning Department were also helpful in providing background and demographic data on the sampling areas.

We wish particularly to thank the large number of Arthur D. Little, Inc. staff members who participated in the sampling and analysis team efforts. Their commitment to the program and their extra hours effort helped make the study a success. The willing cooperation of the corporate facilities staff also helped considerably with the intense start-up effort required for this study.

I. SUMMARY

This report represents the second in a series of studies of sewage treatment basins undertaken in order to determine the relative importance of major sources of pollutants found at the influent of publicly-owned treatment works (POTWs). The general categories of residential, commercial and industrial have been identified as appropriate classifications for this study. This is the third report in the series -- the two previous reports (with the same main title as this report) have been published under the subtitles listed below:

Part I: Literature Review
Part II: Muddy Creek Drainage Basin, Cincinnati, Ohio

This second study was carried out in the drainage basin of the Coldwater Creek treatment plant in the metropolitan St. Louis, Missouri area. In contrast to the predominantly residential character of the Muddy Creek basin in Cincinnati, the Coldwater Creek basin area had a reasonable amount of flow from commercial and industrial sources in addition to the residential flow. The relative flow from these source types in the basin was:

Residential:	78%
Commercial:	10%
Industrial:	12%

Samples (24-hour composites) were collected from 3 residential, 2 commercial and 2 industrial sites, 1 mixed site, tap water and the POTW influent and effluent.

The quality control program initiated in the Cincinnati study was retained for this city. A total of 64 samples, including field blanks, were collected for analysis. Samples were analyzed for all priority pollutants (excluding asbestos) plus manganese, the classical parameters of ammonia, TSS, TOC, BOD, COD, oil and grease, as well as pH and temperature.

The internal standard, d_{10}-anthracene, was added to the aqueous sample prior to extraction and concentration for the acid and base/neutral analyses. The data were analyzed to determine whether the recovery data and, therefore, the individual pollutant concentrations were affected. It was shown that the d_{10}-anthracene was extracted with 95-100% efficiency and, therefore, no correction factor is required.

A total of 47 pollutants, 32 organic priority pollutants, 12 priority pollutant metals plus manganese, total cyanides and total phenols were observed in St. Louis, plus the six classical parameters which were measured. Seventy-nine (79) of the pollutants were never observed, and a number were observed only one or two times. Only 1 pesticide, Aldrin, was observed - twice.

Many of the pollutants were detected at low concentration levels; only five organics and eight metals were present at overall average concentrations greater than 10 μg/L. Three (3) organic pollutants and 6 metals were observed in 90-100% of the samples.

Sources - residential, commercial, industrial - showed the presence of 46 pollutants: 31 organics, 13 metals, total cyanides and total phenols. Source pollutants present at least 50% of the time included 10 organics and 7 metals and total phenols; 14 organics and 3 metals were present in the sources less than 10% of the time.

The concentration data do not show many chemical intensity level differences between the source categories. The mass flow data indicate that more than 50% of the mass of 23 out of 30 priority pollutants and the classical parameters is contributed by the residential sources. However, only phenol, 2 phthalates, antimony, mercury, selenium, and oil and grease have at least 90% of the mass load attributed to residential sites; all others have substantial commercial and/or industrial contributions. Observations concerning residential sites are fairly strong since these sites are almost exclusively residential in terms of water use.

An analysis of water flow within the sites and the basin shows a good closure (within 5%) when the measured flows are compared to those estimated from water use records and a per capita discharge flow. The water use records, therefore, appear to be a reliable index of flow discharge from commercial and industrial sources.

At the Coldwater Creek Water Treatment Plant, samples of the effluent as well as the influent were obtained, enabling an evaluation of the removal efficiencies to be made. The average removal efficiency for the organics was 89%; some of the trihalomethanes displayed removal efficiencies around 65%, and benzene was removed at only 48%. Most of the metals were removed with efficiencies around 70%. However, manganese, nickel and zinc had removal efficiencies of 30%, and selenium exhibited an increase in mass load across the treatment plant. With the exception of ammonia (12%), the removal efficiencies for total cyanides, total phenols, and the classicals were all quite high.

The chemical analysis procedures have been modified for some pollutants. The QC/QA results for the Coldwater Creek survey are very good. Mass recovery values for the organics are in the 80% to 90% range, and precision is generally within 10% to 30%. This is an improvement in comparison to the Cincinnati study. The quality control data also improved considerably for the metals as a result of implementing the recommendations for use of higher spiking levels for certain metals and use of the DC plasma technique.

The quality control program continues to be invaluable in terms of daily checks on the chemical analyses and in terms of establishing the reliability of the data for subsequent calculations and projections.

II. INTRODUCTION

The Office of Water Planning and Standards (OWPS) is concerned with developing a comprehensive regulatory strategy with respect to the toxic pollutants introduced into, and passing through, publicly-owned treatment works (POTWs). The Monitoring and Data Support Division (MDSD) is responsible for determining the sources and extent of pollutants entering the POTW, thereby providing the basis for a control strategy concerned with priority pollutants which may enter the environment via the POTWs.

Toward fulfillment of their above mentioned responsibilities, the MDSD has sponsored an extensive study of POTWs and the collection basins in various cities across the country. The objectives of this POTW source study include defining the various types of source categories, describing those source categories in terms of priority pollutant contributions, and determining the relationship of the individual source measurements to the pollutant burden at the POTW influent. It is hoped that this information can be used to arrive at a means for anticipating the sources of pollutants at the POTWs in treatment areas which have not been sampled.

The sampling and analysis procedure employed in the POTW surveys are those outlined in the EPA Screening Protocol for Priority Pollutants.[1] The first two phases of the program encompassed the literature study of existing information on wastewater treatment and pollutant levels,[2] and the initial field study which was conducted at the Muddy Creek treatment area in Cincinnati.[3] A quality control program was established as part of the initial study in order to be able to ensure confidence in data from the subsequent studies.

This report documents the survey conducted at the Coldwater Creek drainage basin in metropolitan St. Louis, the second in the series of POTW basins to be studied under this MDSD program. The procedures used for sampling and analysis were largely the same as those used for the Cincinnati study.[3] The data base for the St. Louis study is more extensive than that obtained in the Cincinnati study and represents a more diverse set of source types. Therefore, it has been possible to carry out a more comprehensive analysis of the St. Louis data with respect to determining the sources of priority pollutants.

In the selection of the sampling sites within the Coldwater Creek treatment area, attention was given to all three of the major source types and samples were collected from industrial, commercial, and residential areas. In addition, samples of the effluent were taken as part of this study, enabling comparison of priority pollutant levels prior to and subsequent to the POTW treatment processes. Samples were collected at eight sites in addition to the tap, POTW influent, and POTW effluent. Six 24 hour flow-composited samples were obtained for each site.

The presence or absence of priority pollutants at the individual sites or the POTW has been determined by examining the concentration data. The data have also been grouped to determine the sources most responsible for each pollutant observed. Furthermore, efforts have been made to relate the source types to the POTW influent by means of mass balance calculations, enabling the relative importance of different source types to be determined.

In addition to supplying data on a second POTW drainage basin in a different part of the country, this study at the Coldwater Creek POTW in St. Louis has served as a means by which to compare and verify the analytical results of the initial survey in Cincinnati. This comparison is especially appropriate with respect to the quality control program developed for the entire program. In order to be able to extrapolate the knowledge gained from a handful of drainage basins across the nation, it is of utmost importance to ensure the confidence of the individual data sets.

III. COLDWATER CREEK POTW TREATMENT AREA

A. Introduction

The Coldwater Creek POTW treatment area of the Metropolitan St. Louis Sewer District was chosen for the second source sampling study on the basis of the following criteria:

1. The area covered by this POTW was well defined and represented an attempt to isolate independent types of sampling sites (e.g., "pure" old and new residential, commercial or industrial, as well as various mixtures of the above).
2. Sampling test site locations appeared to have adequate and visual flow to allow for 24-hour sample collection.
3. Test sampling locations had safe 24-hour accessibility away from traffic and/or other activities.
4. The cooperation of the Metropolitan Sewer District personnel and availability of background data were expected.
5. The endorsement of the location was strongly supported by EGD and Burns and Roe.

Arthur D. Little staff, along with Burns and Roe and EGD staff, visited with the Manager of Industrial Pollution Control (Bernard Rains), Director of Wastewater Department (Roger Wieting), the Maintenance Supervisor (Edward Kelemen), and other planning and maintenance officials of the Metropolitan St. Louis Sewer District; and the superintendent of the Coldwater Creek Treatment Plant (Patrick T. Karney). The MSD personnel were extremely cooperative and most anxious to take part in the EPA POTW survey. Arthur D. Little staff were taken on a tour through a number of communities within the Coldwater Creek drainage area--Florissant (well established, old residential area), the Bridgeton and Lambert-St. Louis International Airport industrial area, and St. Ann. They were provided with a set of detailed sewer maps, list of significant industries with SIC codes, list of commercial accounts, land use maps, and other pertinent information on the area.

In order to obtain demographic information on the Coldwater Creek Sewage District, the following persons and agencies were contacted:

East-West Gateway Coordinating Council
St. Louis, Mo.
Mr. Glen Griffen, Ms. Sandy Friedman, Mr. George Kadampanet

St. Louis County Planning Department
Clayton, Mo.
Mr. Keith Zeff and Ms. Sandy Paull

During these meetings, copies of publications on housing and census tract analysis, street maps, and historic elements on St. Louis County were obtained.

In collecting economic and demographic information, it was determined that St. Louis had a well maintained system and consolidated set of data on industrial, commercial and residential facilities in the areas chosen for sampling. The St. Louis County Planning Department in Clayton maintains an updated "locator number information system" which shows land use on a parcel-by-parcel basis for the entire area of St. Louis County. The system contains maps and information files. Each map is approximately 20" x 14", covers an average area of 700 acres, and is color-coded by land use type (red--commercial; yellow--residential; blue--public/town; grey--industrial; etc.). The maps also indicate some names of commercial and manufacturing establishments, and show the number of apartment units, duplexes, single family, vacant lots, schools, parks, etc. Each map is assigned a "map locator" number. From the locator system, a computer printout entitled "The Merchants and Manufacturers Data by Transporation Zone" (MMDTZ) was obtained. From this printout we were able to obtain names and addresses of merchants and manufacturers, SIC codes, building area in square feet, and number of employees. In some cases, the building area and numbers of employees were not available. Staff at the St. Louis County Planning Department were very cooperative and helpful in explaining their "map locator system" and assisted in determining which particular maps and reference material we needed for our sampling areas. The appropriate maps and reference materials were copied for our analysis and files.

The demographic data obtained for the St. Louis POTW analysis are more complete and accurate than data obtained during the initial sampling study done for the Muddy Creek treatment area in greater Cincinnati, Ohio.

From the above sources, we were able to obtain the following demographic data for each sampling site location:

> Housing--number of single family, duplex, multi-family, number of apartments and total units for each, estimate of vacant homes and lots
>
> Commercial--total number of commercial establishments by name, address, SIC code, building area in sq ft and estimated number of employees
>
> Institutional and Professional--number of schools, churches, municipal offices, medical buildings, pools, tennis courts, etc.
>
> Open Land--parks, common grounds, cemetaries, undeveloped lots, forest areas, etc.
>
> Population--estimated population by a housing-based count using an average of 3.6 persons/unit for single family and 2.6 for other units.

In the following sections the Coldwater Creek POTW, the Coldwater Creek treatment area, and each sampling area are described. Details of the sampling plan are presented in Section IV.

B. Coldwater Creek POTW

The Coldwater Creek treatment plant was completed and went into operation in late 1965. The plant is located on the creek at Old Halls Ferry Road. It serves a 34-square-mile watershed extending from Lambert Airport to the Missouri River. Approximately 26.5 million gallons per day of wastewater are treated within the plant, with an estimated 10% industrial flow.

The Coldwater Creek POTW received the "Treatment of the Year" award of the Missouri Water Pollution Control Association in 1968.

The plant provides secondary treatment using the activated sludge process with three-stage sludge digestion and ultimate disposal of sludge in storage basins (see Figure 1). Suspended solids are removed with a 90% efficiency. The plant has a design capacity of 25 MGD (peak flows reach 45 MGD) and has the capability of providing primary treatment for peak flows up to 75 MGD.

Coldwater Creek has separate storm and sanitary sewage systems. Stormwater is channeled to either the Coldwater Creek or one of its tributaries with final discharge into the Missouri River. Sanitary wastes are collected within the one main interceptor and in most cases gravity fed to the Coldwater Creek POTW for treatment.

C. General Description of the Coldwater Creek POTW Treatment Area

The Coldwater Creek Drainage Basin lies north and northwest of Metropolitan St. Louis. All areas serviced by this system are outside the city limits but lie within St. Louis County. The length of the area (north to south) is approximately 8 miles, with the width varying from 3-8 miles (east to west). Figure 2 outlines the sewer system and main roads within the treatment area, and shows the location of the sampling areas. The treatment area contains 45,898 acres (34-square miles) and has an estimated population of 200,000. There are currently 2611 industrial and commercial accounts, 44,057 one-family structures and 2360 multi-family structures (totaling 12,086 units) within the drainage basin.* Figure 3 displays the land use within the treatment area with respect to the residential, commercial, industrial and open spaces.

1. Communities and Residential Areas

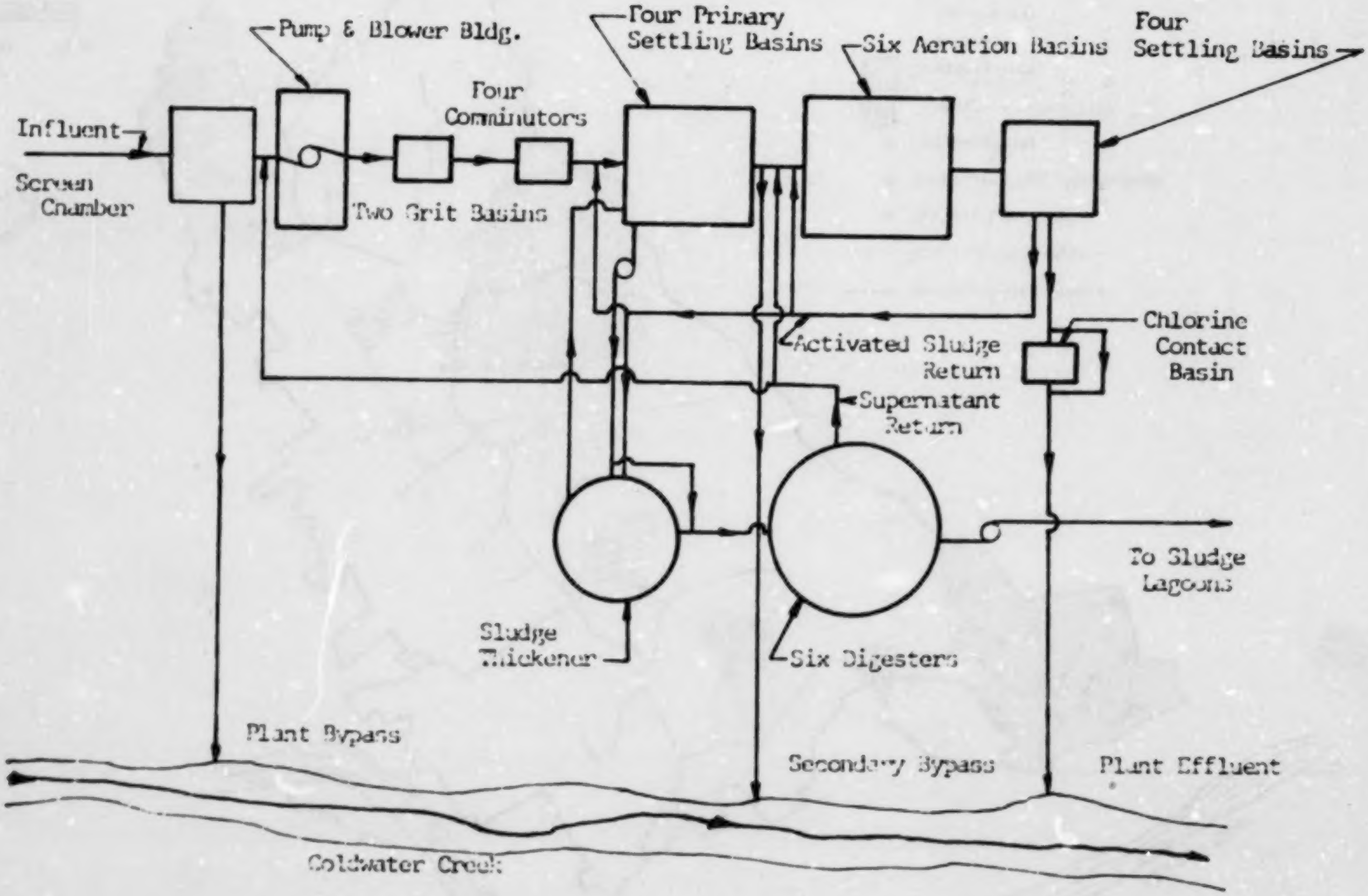
Fifteen (15) incorporated villages, towns and cities lie in part or completely within the drainage area. Included are:

---

*Figures obtained from water bill accounts of the Billing Department, Metropolitan Sewer District, St. Louis, Mo.

Figure 1

FLOW DIAGRAM - COLDWATER CREEK TREATMENT PLANT


Influent
Screen Chamber
Pump & Blower Bldg.
Two Grit Basins
Four Comminutors
Four Primary Settling Basins
Six Aeration Basins
Four Settling Basins
Chlorine Contact Basin
Activated Sludge Return
Supernatant Return
Sludge Thickener
Six Digesters
To Sludge Lagoons
Plant Bypass
Secondary Bypass
Plant Effluent
Coldwater Creek

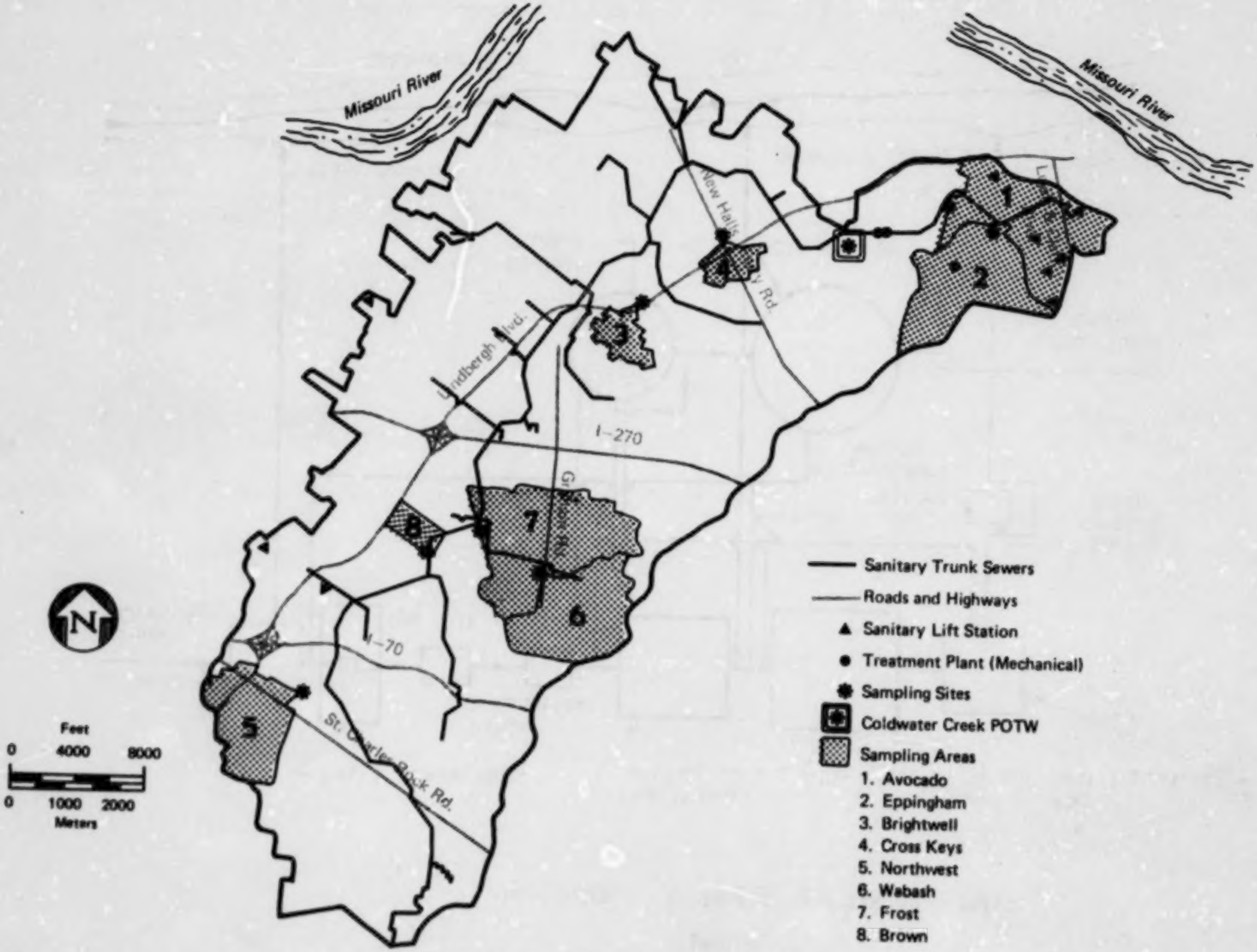

Missouri River
Missouri River
New Halls Ferry Rd.
Lindbergh Blvd.
I–270
Graham Rd.
I–70
St. Charles Rock Rd.
1
2
3
4
5
6
7
8
N
Feet
0
4000
8000
0
1000
2000
Meters
Sanitary Trunk Sewers
Roads and Highways
▲ Sanitary Lift Station
● Treatment Plant (Mechanical)
Sampling Sites
Coldwater Creek POTW
Sampling Areas
1. Avocado
2. Eppingham
3. Brightwell
4. Cross Keys
5. Northwest
6. Wabash
7. Frost
8. Brown

FIGURE 2 COLDWATER CREEK TREATMENT AREA

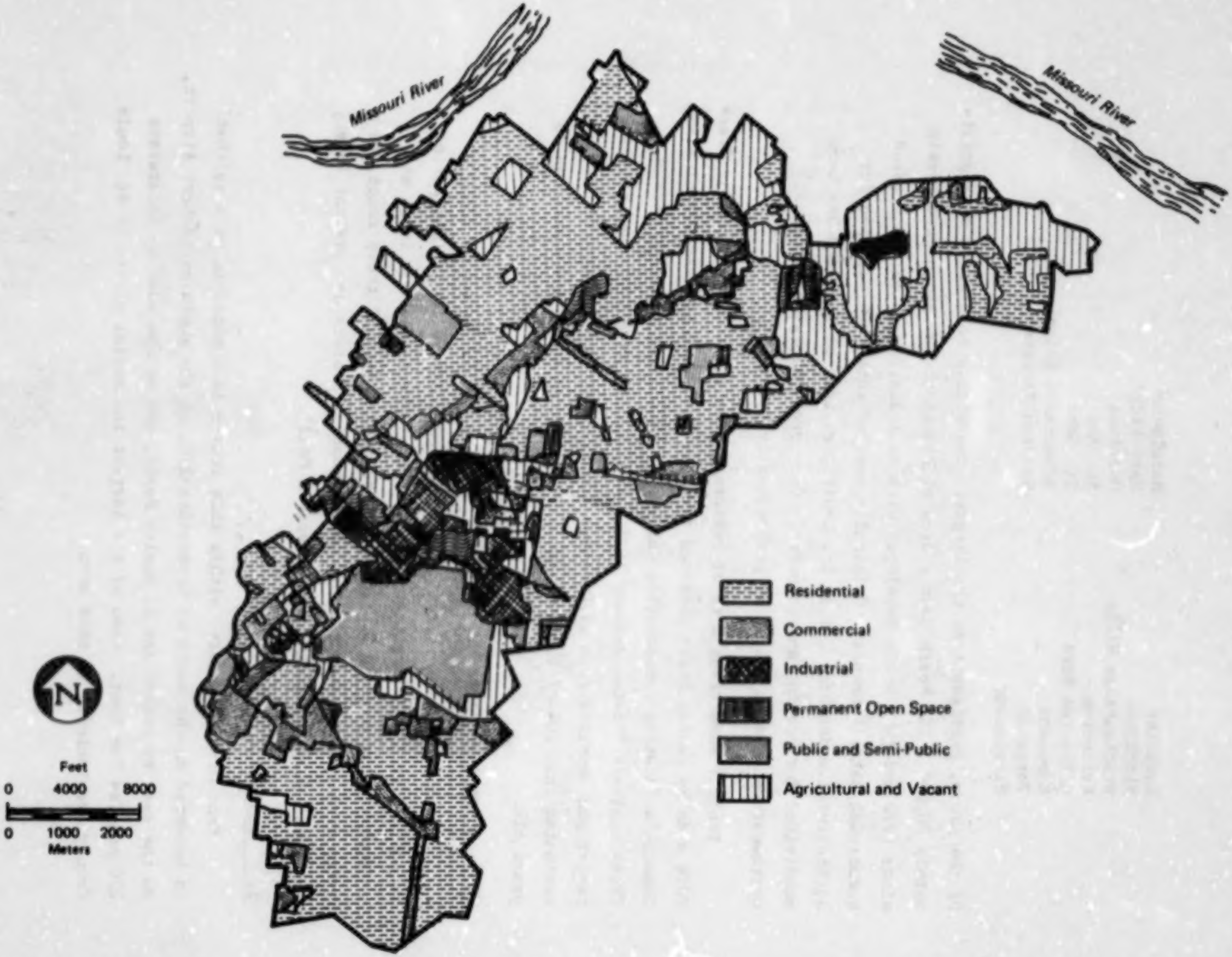

Missouri River
Missouri River
Residential
Commercial
Industrial
Permanent Open Space
Public and Semi-Public
Agricultural and Vacant
N
Feet
0
4000
8000
0
1000
2000
Meters

FIGURE 3 COLDWATER CREEK TREATMENT AREA – LAND USE

Berkeley
Blackjack
Breckenridge Hills
Bridgeton
Calverton Park
Edmunson
Ferguson
Florissant
Hazelwood
Navy Ridge
Overland
St. Ann
St. John
Scheurmann Heights
Woodson Terrace

Of the above, Florissant is the largest area with a population of approximately 70,000. The North County area of Blackjack has grown extensively since 1970 and is now 80% developed with no industry and only scattered commercial establishments. Originally most of this land was used for agricultural endeavors, but as St. Louis grew much of the land has been subdivided for housing and commerce. Only areas along the north and northwestern borders are still predominantly open.

Table 1 summarizes ages of residences for the entire Coldwater Creek POTW area by census tract obtained from the East-West Gateway Coordinating Council's "Housing Conservation Guide for the St. Louis Region Census Track Analysis," dated January 1978. Most of the data contained in this report was compiled from 1970 census information. In summary, it is estimated that 20% of the residences in Coldwater Creek are more than 20 years old.

2. Commercial Areas

Major commercial sectors within the area can be found in a north to south direction along Lindbergh Boulevard (Route 67) and in an east to west direction along St. Charles Rock Road. Most of these zones are strip commercial, however a few major shopping centers are present (e.g., Northwest Shopping Center and Jamestown Mall).

3. Industrial Areas

Most of the industry within this region is located in an area that is bordered on the north by Interstate 270, on the south by Lambert Airport, on the east by Graham and N. Hanley Roads, and on the west by Interstate 270 and Fee Fee Road. Some of the largest industrial plants in St. Louis County are included in this area.

Table 1

AGE OF RESIDENCES FOR ENTIRE COLDWATER CREEK POTW AREA BY CENSUS TRACT ANALYSIS

Census Tract #	% Units Less Than 10 Yrs	% Units Between 11-20 yrs	% Units Older Than 20 Yrs	Population 1970 Census	Estimated Units—1970[a]	Number of Units Older Than 20 Yrs	Number of Units Less Than 20 yrs
2114	66.8	12.0	21.2	7,333	2036	431	1605
2115	20.4	71.9	7.7	4,972	1381	106	1275
2116	35.6	50.7	13.7	9,199	2552	349	2209
2126 (1/4)	8.4	47.0	44.6	1,700	472	209	263
2117 (3/4)	20.3	51.0	28.7	1,310	363	104	259
2129	9.3	57.0	33.7	7,189	1997	672	1325
2130	76.6	13.4	10.0	2,065	568	56	512
2131.01 (1/4)	76.4	19.4	4.3	2,600	722	31	691
2131.02 (1/4)	74.6	9.1	16.2	1,000	277	44	233
2148	9.6	44.8	45.7	8,038	2233	1020	1213
2133	44.3	41.0	14.3	10,609	2947	421	2526
2134	15.6	51.7	32.8	10,385	2884	965	1939
2135	11.1	37.0	51.9	7,211	2003	1039	966
2147	18.5	40.8	40.7	9,770	2714	1104	1610
2149 (1/4)	40.7	34.3	25.0	1,600	444	111	333
2146 (1/2)	20.0	34.2	45.7	6,500	1805	826	981
2144	11.4	16.7	73.9	7,766	2157	1594	563
2109.02	96.5	2.0	1.1	8,268	2296	25	2271
2109.01	63.1	13.4	23.4	3,410	947	221	726
2109.03	80.9	15.4	3.7	9,662	2683	99	2584
2108.01	90.3	4.6	5.1	9,138	2538	129	2409
2108.02 (1/2)	88.5	8.5	2.9	6,200	1722	49	1673
2110	48.2	47.8	4.0	11,089	3080	123	2957
2111	36.7	56.0	9.3	14,884	4134	384	3750
2113.02	67.6	31.6	0.8	5,811	1614	12	1602
2113.01	36.1	57.6	6.3	11,003	3056	192	2864
2113.02	83.3	12.7	4.0	5,811	1614	64	1550
2112	48.0	41.7	10.3	11,991	3330	342	2988
Totals				196,494	54,569	10,700	43,875
Average	46%	33%	21%			20.0%	80%

Source: East-West Gateway Coordinating Council, "Housing Conservation Guide for the St. Louis Region Census Tract Analysis," January 1978 (based on 1970 census data).

a) Estimated on the basis of 3.6 persons/unit developed from census data.

D. Overall Description of Sampling Sites Within Coldwater Creek Treatment Area

As mentioned earlier, Figure 2 shows the Coldwater Creek treatment area and the location of each sampling area. Table 2 gives some of the characteristics of the sampling sites within the Coldwater Creek treatment area. Table 3 summarizes the demographic data for each sampling site. Housing-based population estimates were obtained by using 3.6 persons per single family unit and 2.6 persons per apartment unit, except as noted. Land-use maps and demographic tables for each sampling area are included below.

1. Avocado and Eppingham

The Eppingham sampling area is a subset of the Avocado area, located in Blackjack in northern St. Louis County. Figure 4 shows the streets, sampling locations, and land use for the Avocado and Eppingham areas.

The Avocado sampling area is characterized as a new residential area, 95% of the housing stock less than 20 years old. There was much new construction from 1970-1974 when the Ferguson-Florissant and Hazelwood School Districts gained population. The estimated housing-based population obtained for Avocado is 6,929. The commercial area consists primarily of the Jamestown Mall located at State Highway 140 and Old Jamestown Road, and the Paddock Village Shopping Center at Benham and Parker. There are many undeveloped areas, common ground, large undeveloped lots, park areas and a lake.

Data characterizing the Avocado sampling area alone is summarized in Table 4. This table does not combine the Eppingham subset sampling area.

Table 2

CHARACTERISTICS OF SAMPLING SITES

Sampling Site	Description of Area Source Type/Sewer Type	Sampling Location (Longitude : Latitude)	Sewer Characteristics
Eppingham	New Residential/ Sanitary	90° 14' 40.1" 38° 48' 49.4"	18" vitrified clay 0.5% slope 20.6' deep
Avocado	New Residential/ Sanitary	90° 15' 22.7" 38° 49' 1.2"	24" reinforced concrete 0.11% slope 9.5' deep
Brightwell	Old Residential/ Sanitary	90° 19' 0.9" 38° 47' 56.9"	10" vitrified clay 0.48% slope 8.8' deep
Wabash	Old Residential-Industrial/ Sanitary	90° 20' 19.3" 38° 45' 23.2"	21" concrete 0.22% slope 8.5' deep
Cross Keys	Commercial-Residential/ Sanitary	90° 18' 13.8" 38° 48' 27.2"	10" vitrified clay 0.49% slope 12' deep
Northwest	Commercial-Residential/ Sanitary	90° 23' 30.9" 38° 44' 4.0"	18" vitrified clay 0.11% slope 9.8' deep
Frost[a]	Industrial-Residential/ Sanitary	90° 20' 59.6" 38° 45' 50.1"	24" reinforced concrete 1.1% slope 8.3' deep
Brown	Industrial/ Sanitary	90° 21' 39.8" 38° 45' 36.9"	8" vitrified clay 1.1% slope 11.9' deep

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[a] Flow measurements were taken one hole upstream of sampling location.

Table 3

SUMMARY DEMOGRAPHIC DATA - ST. LOUIS POTW SAMPLING SITES

	HOUSING			POPULATION		COMMERCIAL			INSTITUTIONAL				INDUSTRIAL			MAJOR SIC CODES		
SAMPLING SITE	Number Single Family	Number Multiple Units	Total Units	1970 Census	Housing Based	Total No.	No. Empl.	Bldg Area Sq ft	No. Schools	No. Munic. Office	No. Church	Other	No. Estab.	No. Empl.	Bldg Area Sq Ft	2-Digit Code	Category	No. Emp
EPPINGHAM--subset of Avocado--new residential	641	Apt 382	1023	2263	3300[a]	13	103	53,700	3	-	1	tennis	-	-	-	-	-	-
AVOCADO--combined with Eppingham--new residential	1649	Apt 382	2031	2848	6929[a]	106	1212	336,675	4	-	3	cem. tennis	-	-	-	-	-	-
BRIGHTWELL--old residential	425	Apt 6	531	1240	1545[a]	38	158+	71,900	-	3	-	tel. co.	-	-	-	-	-	-
WABASH (subset of Frost)	1800	Apt 44 Dup 8	1852	6483	6615[a]	59	159	127,064	4	2	4	dent.	23	144	83,570+	34 51 35 28 21	Fab Metal Wholesale Trade Machinery Chem & Allied Tobacco	77 8 9 9 8
FROST (combines Wabash)--indus/res	3025	Apt 246 Dup 8	3279	12,761	11,222[b]	81	225+	166,714	6	2	4	dent. chirop.	58	2445	2 million	48 34 28 42 26	Communication Fab Metal Chem. & Allied Trans & Warehous Paper & Allied	619 527 170 143 125
NORTHWEST--commercial & res	864	Dup 42 Apt 242 (+ 4 hotels)	1148	2730	3160[c]	174	2243+	3 mil.	3	2	3	K.C., cem., med. bldg	1	26	13,600	26	Paper & Allied	26
BROWN (pure industrial)	0	0	0	0	-	4	26	46,400	-	-	-	-	14	433	751,950+	33 34 51 29 24	Prim Metal Fab Metal Wholesale Trade Petro & Refining Lumber & Wood	150 95 59 45 35
CROSS KEYS (commercial & res)	66	Apt 963	1029	608	2124[c]	75	434	300,462	1 K.G.	-	-	elec co. pool	-	-	-	-	-	-
Totals	8470	1889	8018	20,187	24,980	478	4298	3.9M+	14	7	10		73	2904	2.8M+			

a) Based on 3.6 persons/unit single family, 2.6 persons/unit for other units (developed from census data); b) based on 3.5 persons/unit single family, 2.5 persons other units; c) based on 3 persons/unit single family, 2 persons/unit other.

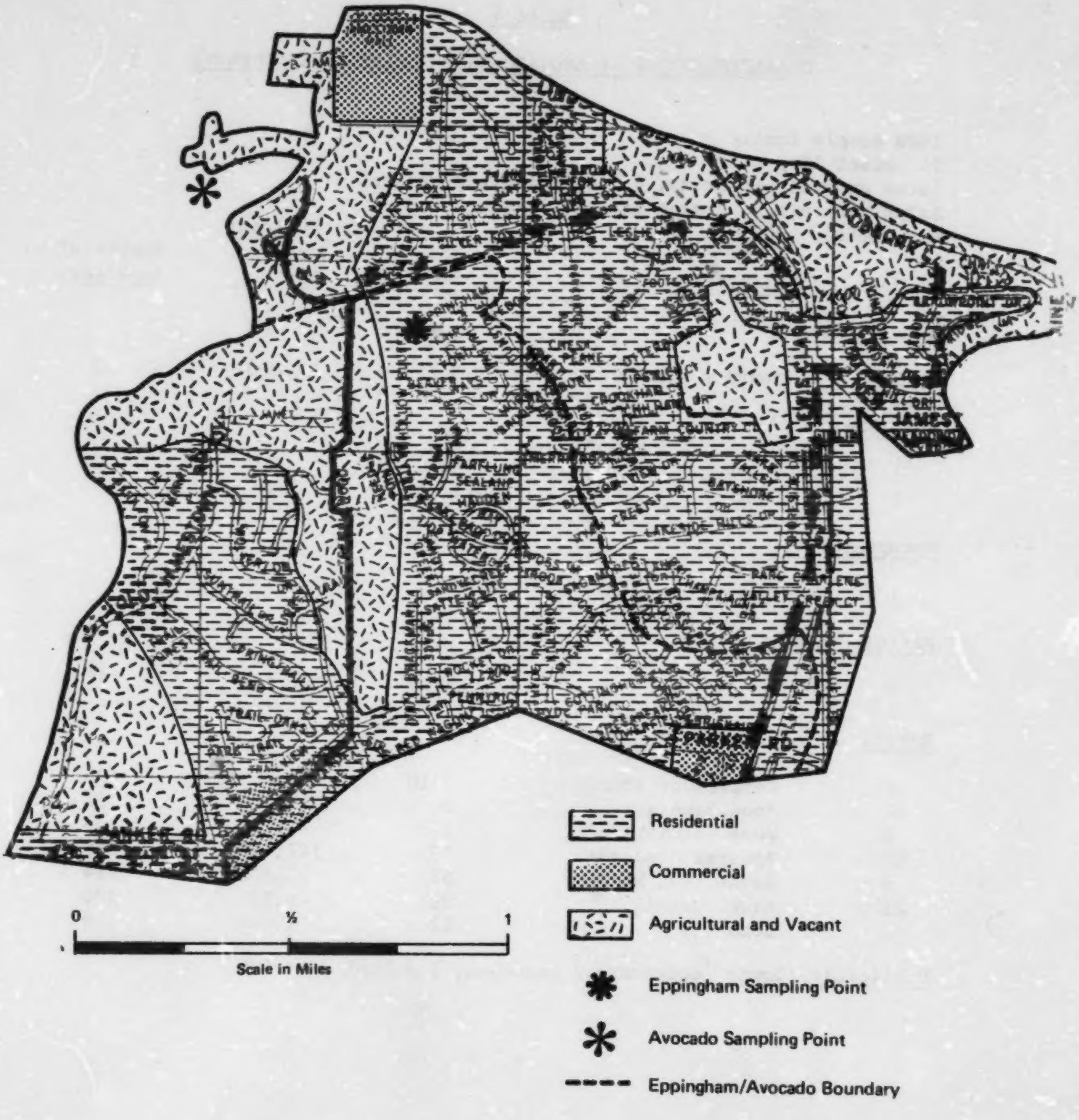

PARKER RD.
JAMES
0
½
1
Scale in Miles
Residential
Commercial
Agricultural and Vacant
Eppingham Sampling Point
Avocado Sampling Point
Eppingham/Avocado Boundary

FIGURE 4 AVOCADO AND EPPINGHAM – LAND USE AND STREETS

Table 4

CHARACTERISTICS OF AVOCADO (not including Eppingham)

1008 single family
94 vacant lots
large undeveloped areas, 4 large lots undeveloped
large park areas, common ground, 1 lake
Population: 3629

No.	Classification	SIC Code	Building Area in Sq Ft	Number of Employees
Auto Related				
3	Service Stations	5520	1,000	7
Services				
1	Tux Rental	7254	800	3
1	Bank	6011	--	--
Entertainment				
1	Cinema			
Eating Places				
6		5810	21,540	96
Retail				
3	Department Stores	5310	414,000	675
4	Food/Bakeries	54	5,300	21
2	Home Furnishing	57	750	5
47	Apparel & Access.	56	147,732	268
3	Radio, TV, Music	52	13,900	14
21	Misc. Retail	59	48,913	100
1	Security	62	1,640	9

Public/City/Town: cemetery, 2 churches, 1 school district

The Eppingham sampling area is characterized as new residential with most of the housing stock less than 15 years old. Our housing-based population estimate, using the same number of persons per unit as Avocado, is 3,300 compared to the 1970 census data population of 2,263. This represents an increase in population of 1100 since 1970. Commercial establishments consist only of a very small shopping center (approximately 10 establishments). There is some undeveloped open land space and large and small forest areas. Data summarizing the types of establishments in the Eppingham area are shown in Table 5.

2. Brightwell

The Brightwell sampling area is located off Lindbergh Boulevard in Florissant in the northwest part of St. Louis County. Figure 5 shows the land use and major streets in the area.

The Brightwell sampling area is characterized as old residential, with isolated commercial. The housing stock is approximately 50-60 years old. Our housing-based population estimate is 1545 compared to the 1970 census data of 1240. Data summarizing Brightwell Court are given in Table 6.

3. Crosskeys

The Crosskeys sampling area is located at the intersection of New Halls Ferry Road and Lindbergh Road in Florissant in northern St. Louis County. Figure 6 shows the land use and main streets in the area.

The Crosskeys sampling area is characterized as a commercial/residential site. The commercial establishments consist mainly of the Crosskeys Shopping Center and others that are located along Lindbergh Boulevard and New Halls Ferry Road. There are a total of 75 commercial establishments containing over 300,000 square feet of building area and employing over 400 persons.

The housing stock in the residential areas is new with approximately 95% being constructed since 1950. Our housing-based population estimate for this site is 2124 compared to the 1970 census data of 608; or an increase of approximately 1516 since 1970. This large increase is accounted

Table 5

CHARACTERISTICS OF EPPINGHAM

641 single family
47 vacant lots
3 apartment buildings = 382 units
large and small forest areas
large undeveloped open land space
Population: 3300

No.	Classification	SIC Code	Building Area in Sq Ft.	Number of Employees
Auto Related				
1	Service Stations	5541	2,400	3
Services				
1	Beauty Shop	7231	2,000	5
Retail				
2	Apparel & Access.	56	2,800	1
1	Radio, TV	5731	2,100	2
1	Furniture, home furn.	5713	3,550	3
1	Grocery Store	5410	21,400	40
1	Drug Store	5910	12,500	15
2	Misc. Retail	5995	1,600	5
Eating Establishments				
3	Rest.	5820	5350	29
Entertainment				
1	Cinema			

Public/City/Town: 2 tennis court areas, 3 schools, 1 church

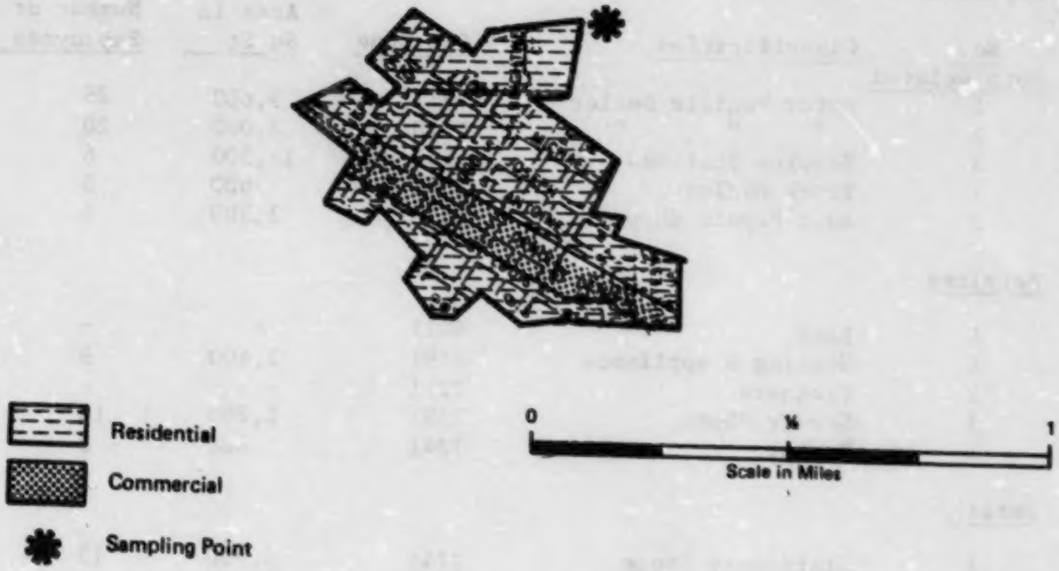

Residential
Commercial
Sampling Point
0
½
1
Scale in Miles

FIGURE 5 BRIGHTWELL – LAND USE AND STREETS

Table 6

CHARACTERISTICS OF BRIGHTWELL

Old residential (with isolated commercial)
approx. 50-60 years old
425 single family
16 vacant lots
1 apartment building = 6 units total
Population: 1545

No.	Classification	SIC Code	Building Area in Sq Ft	Number of Employees
Auto Related				
1	Motor Vehicle Dealer	5511	9,600	26
1	" " "	5520	8,000	20
3	Service Stations	5541	16,500	6
1	Truck Dealer	5514	600	6
2	Auto Repair Shops	7538	3,300	6
Services				
1	Bank	6011	-	-
1	Heating & Appliance	6491	2,400	8
1	Cleaners	7211	-	-
3	Beauty Shops	7231	1,200	10
1	Barber	7241	600	2
Retail				
1	Stationery Store	2741	4,900	13
1	Paints, Varnishes	2850	4,000	1
1	Structural clay products	3259	300	2
1	Building materials	5212	2,400	2
1	Photography	5043	400	1
4	Grocery Stores	5411	4,700	9
1	Electrical	5240	-	-
2	Misc. shopping stores	5951	1,300	6
1	Nonstore retailer	5968	800	2
1	Jewelry stores	5944	-	1
1	Retail-ceramics	5990	2,400	2
1	Florist	5992	700	2
1	Misc. retail	5995	1,500	2
Recreational				
1	Tavern	5820	500	1
Eating Places				
5	Fastfood/Rest.	5810	5,800	30

Public/Town/City: 1 city hall, 1 police department, 1 telephone company.

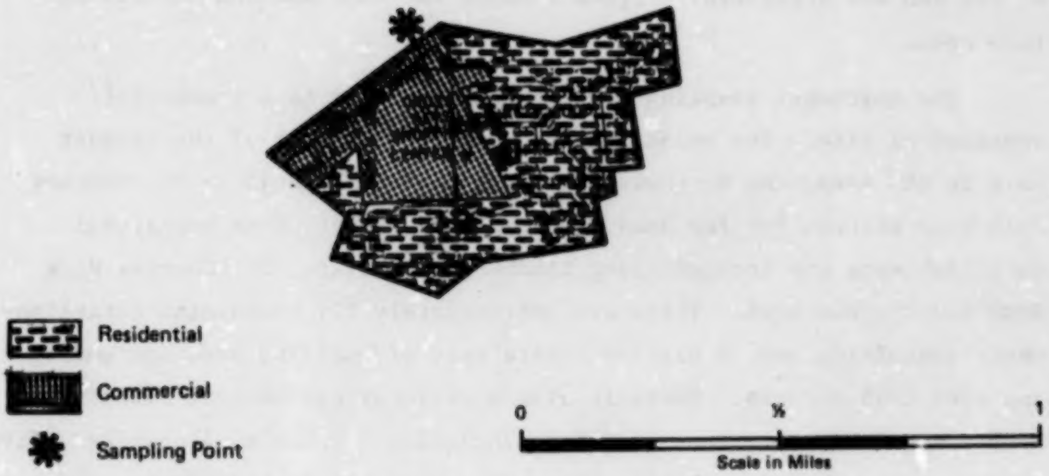

Residential
Commercial
Sampling Point
0
½
1
Scale in Miles

FIGURE 6 CROSS KEYS – LAND USE AND STREETS

for by the added construction and occupancy of the apartment buildings. Data summarizing the types of establishments within the Crosskeys sampling area is given in Table 7.

4. Northwest

The Northwest sampling area is located south of Lambert Airport in the western portion of St. Louis County. It includes parts of the cities of St. Ann and Bridgeton. Figure 7 shows the land use and streets in this area.

The Northwest sampling area is characterized as a commercial/residential site. The commercial area consists mainly of the largest mall in the area, the Northwest Shopping Center, located on St. Charles Rock Road between Fee Fee Road and Adie Road. Most other commercial establishments are located along Lindbergh Boulevard, St. Charles Rock Road and Cypress Road. There are approximately 174 commercial establishments containing over 3 million square feet of building area and employing over 2245 persons. There is also a professional medical building, a number of public/city/town buildings including 3 schools, 3 churches, fire department, street department, etc. There were approximately 6 vacant establishments at the time of our sampling.

Approximately 10% of the homes to the east of Lindbergh Boulevard and south of St. Charles Rock Road are less than 20 years old; 30% of the rest of the site area are less than 20 years old. Our estimated housing-based population is 3,160 compared to 1970 census data of 2,730. There is one industrial establishment employing approximately 26 with a building area of 13,600 square feet. Data summarizing the Northwest sampling area are given in Table 8.

5. Wabash

The Wabash sampling area is a subset of the Frost sampling area (described later). The area is located east of the Lambert Airport. A large portion is part of the Berkeley municipality and the small portion to the north of Wabash Ave. and east of Graham Road is part of Hazelwood and Berkeley communities. Figure 8 shows the Wabash subset

Table 7

CHARACTERISTICS OF CROSSKEYS

66 single family
3 apartment complexes = 963 units
Population: 2124

No.	Classification	SIC Code	Building Area in sq ft	Number of Employees
Auto Related				
1	Car Wash	5530	1,500	3
5	Service stations	5541	54,172	21
2	Auto supplies	5520	10,284	6
Services				
1	Bank	6121	-	-
1	R.E. office	6531	-	-
3	Beauty shops	7231	2,600	10
2	Barbers	7241	1,500	6
2	Shoe repair	7251	936	2
1	Tux rental	7254	800	1
Retail				
1	Paper products	5111	6,000	11
1	Stationery supply	5112	7,000	3
1	Alcoholic Bev. - Wholesale	5185	-	-
1	Hardware Store	5251	24,000	14
1	Grocery Store	5410	48,000	92
1	Misc. Food	5450	2,400	3
3	Family clothing	5650	9,240	11
1	Household appliance	5720	3,000	3
2	Radio, TV	5731	7,100	9
1	Furniture store	5712	-	3
1	Misc. home furn.	5719	1,800	1
4	Drug stores	5910	35,544	32
1	Liquor store	5920	15,000	8
3	Sporting goods	5941	3,831	6
1	Misc. Retail	5952	2,380	2
1	Misc. goods	5969	1,800	2
2	Jewelry stores	5970	3,160	5
10	Misc. retail	5999	15,360	8
Eating Establishments				
16	Eating & Drinking Places	5810	20,060	167

Entertainment: 1 cinema, 1 lounge

Public/City/Town: Electric company, kindergarten, pool

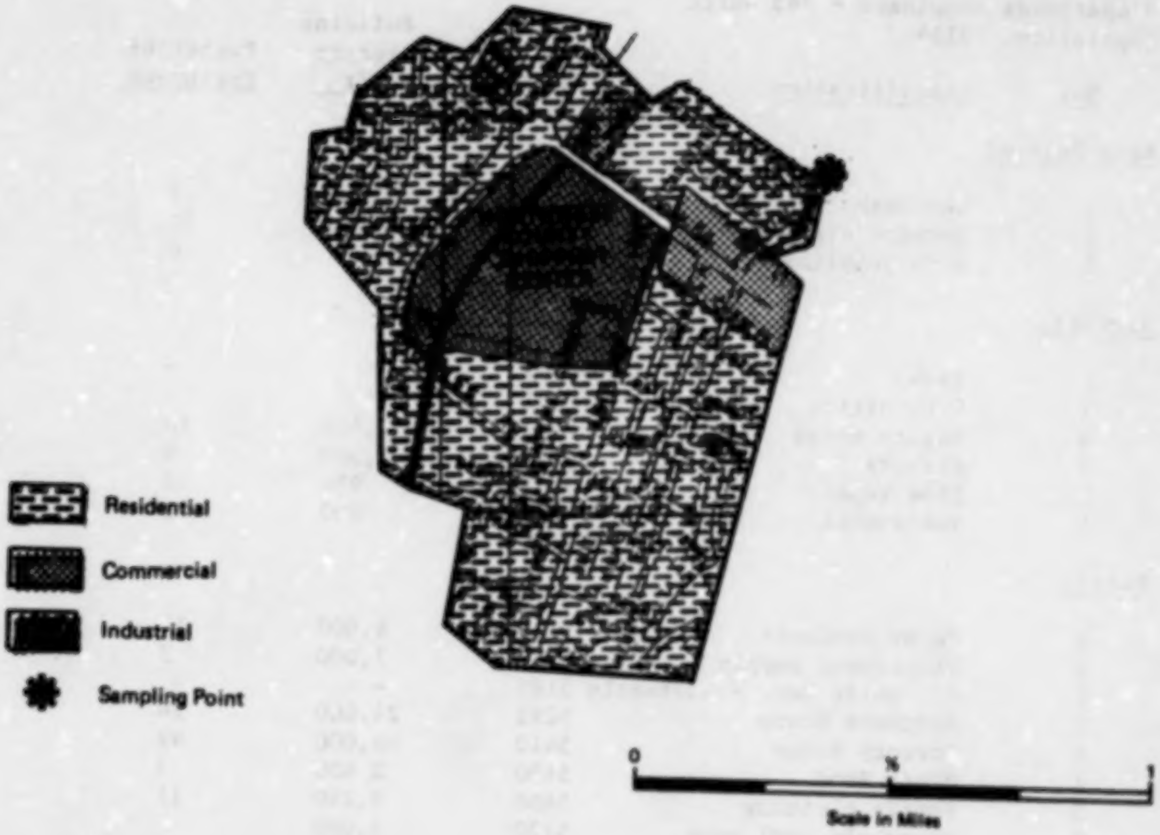

Residential
Commercial
Industrial
Sampling Point
0
½
1
Scale in Miles

FIGURE 7 NORTHWEST – LAND USE AND STREETS

Table 8

CHARACTERISTICS OF NORTHWEST

864 single family
148 vacant lots
242 apartment units
21 duplexes
4 hotels
Population: 3160

No.	Classification	SIC Code	Building Area Sq Ft	No. of Employees
Auto Related				
2	Motor Vehicle Dealers	5511	843,000	118
9	" " "	5520	51,400	62
8	Auto & Home supply	5530	66,400	22
1	Auto Repair/Garage	7538	--	-
Retail				
1	Misc. nondur. goods	51	-	-
1	Bldg. Mat./Hardware	52	2,400	2
7	Gen. Merchandise/Depart. Stores	53	1,072,100	1122
11	Grocery/bakery	54	69,890	129
1	Boat dealer	55	8,000	4
60	Apparel & access.	56	158,770	373
17	Home Furnishings	57	77,050	74
36	Retail stores, not otherwise classified	59	204,107	139
1	Stone, clay products	3258	3,200	2
Services				
1	Household Appliances	5720	10,000	10
1	Savings & Loan Assoc.	6121	-	-
2	Credit agencies	6111	7,500	55
1	Laundry	7211	-	-
6	Beauty Shops	7231	7,870	31
2	Tux rental	7254	2,600	4
1	Funeral service	7261	4,000	1
1	Moving & Storage	4214	-	-
1	Shoe Repair	7251	300	2
Eating Establishments				
19	Rest.	58	42,010	289

Table 8 (Continued)

No.	Classification	SIC Code	Building Sq Ft	No. of Employees
Recreational				
2	Theatres			
2	Lounges	5820	2,500	6
Industrial				
1	Converted paper & paperboard products	2649	13,600	26

Vacant Stores: Approximately 6 vacant retail stores

Professional: 1 medical building

Public/City/Town/Non-Profit: 3 schools, 1 fire house, 1 street department, 3 churches, 1/2 cemetary, 1 K of C

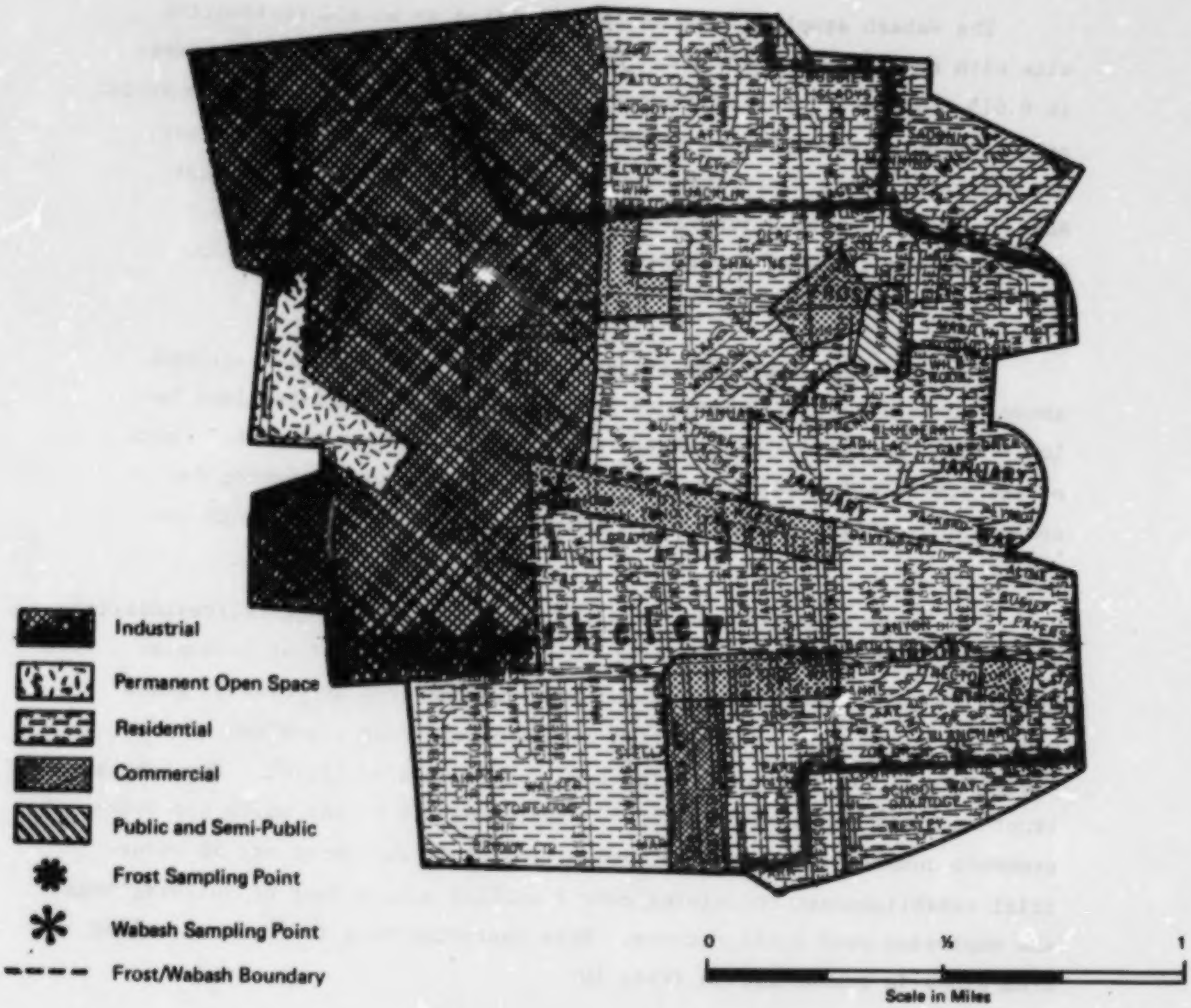

Industrial
Permanent Open Space
Residential
Commercial
Public and Semi-Public
Frost Sampling Point
Wabash Sampling Point
Frost/Wabash Boundary
0
½
1
Scale in Miles

FIGURE 8 FROST AND WABASH – LAND USE AND STREETS

within the Frost sampling area, displaying land use and the major streets in the areas.

The Wabash sampling area is characterized as an old residential site with homes 40-50 years old. Our housing-based population estimate is 6,615 compared to the 1970 census data of 6,483. Fifty-nine commercial establishments, employing over 159 people in over 127,000 square feet, are scattered along Evergreen, Wabash, Garfield, Madison and Airport Roads. There is also a junkyard located on Oakridge Road. Table 9 summarizes the types of establishments in the Wabash sampling area.

6. Frost

The Frost sampling area includes the subset of Wabash described above. Data given for Wabash are included in the Frost data given below. The area is located east and northeast of Lambert Airport. Parts of the area are in Hazelwood, Berkeley, Florissant and Calverton Park communities. Figure 8 shows the land use and main streets within the area.

The Frost sampling area is characterized as an industrial/residential site. It has the most diversified blend of industry east of Coldwater Creek. Twenty percent (20%) of the homes in the area are over 30 years old. Our housing-based population estimate for Frost (combined with Wabash) is 11,222 compared to the 1970 census data of 12,761. The census tract analysis (tract 2129) report(4) indicates 17% of the units are overcrowded; compared to a regional proportion of 9.4%. There are 58 industrial establishments containing over 2 million square feet of building area and employing over 2,445 persons. Data characterizing the Frost sampling area alone is summarized in Table 10.

7. Brown

The Brown sampling area is located just north of Lambert Airport, and includes parts of Byasse Drive, Brown Road and No. Lindbergh Blvd.

Table 9

CHARACTERISTICS OF WABASH

1800 single family
160 vacant lots
80 vacant homes
4 duplex homes
1 apartment building - 44 units
1 junkyard
5 parks
Population: 6615

No.	Classification	SIC Code	Building Area sq ft	No. of Employees
Auto Related				
1	Auto Dealer	5513	1,600	1
3	" "	5520	3,400	6
7	Service Stations	5541	7,490	12
1	Auto Dealer--Tops	5599	15,000	1
3	Auto Dealer/Garage	7538	10,000	12
Services				
2	Plumbing Service	1711	1,750	21
3	Fuel Service	5983	23,275	11
1	Laundry	7211	-	-
1	Shoe Repair	7251	500	1
1	Beauty Shops	7231	72	1
2	Barbers	7241	1,190	2
1	Tax Service	7299	-	-
1	Lock & Key Service	--	-	-
1	Misc. Repair Shops	7699	200	2
Recreational				
1	Swim Club			
1	Bowling Alley	5820	23,800	7
3	Taverns	5820	3,500	7

Professional: 1 Dentist

Eating Establishments

No.	Classification	SIC Code	Building Area sq ft	No. of Employees
4	Rest.	5810/5811	4,500	24

Vacant Buildings: Approximately 8 vacant buildings

Table 9 (Continued)

No.	Classification	SIC Code	Building Area Sq Ft	No. of Employees
Retail				
1	Apparel	5133	6,000	3
1	Beer, Wine, wholesale	5181	1,000	3
2	Hardware Stores	5251	2,400	3
1	Variety Store	5330	1,200	2
2	Grocery Stores	5410	1,600	1
1	Candy, Nuts & Confec.	5440	625	5
1	Misc. Dealers	5591	-	-
1	Family Clothing	5650	-	-
1	Shoe Store	5660	1,000	2
1	Misc. merchandise	5932	1,400	1
2	Liquor stores	5920	2,992	5
1	Florist	5991	720	1
5	Misc. Retail	5999	9,700	23
1	Food service--retail	5411	500	-
1	Misc. Shopping Goods	5969	1,500	1
1	News Dealers	5994	150	1
Industrial				
2	Tobacco Manufac.	2197	8,700	8
1	Misc. Wood Products	2499	3,000	4
1	Misc. Publishing	2740	3,000	4
1	Paints, Varnishes, Allied	2850	8,000	9
1	Steel Works	3315	4,520	4
3	Cutlery, hand tools	3426	4,000	19
1	Heating Equip.	3436	1,600	3
1	Fabricated Metal Prod.	3441	-	3
5	Misc. Fabricated Metals	3499	12,350	52
1	Engines & Turbines	3510	1,500	2
1	Farm & Garden Equip	3525	5,000	7
1	Chemicals & Allied Prod	5163	-	-
1	Alcoholic Bev. - Wholesale	5189	2,750	3
1	Paints, Varnishes	5198	7,000	3
1	Nondurable goods	5199	22,150	8
1	Roofing	176	-	15

Public Buildings: 4 schools, 1 city hall, 1 post office, 4 churches

Table 10

CHARACTERISTICS OF FROST

Most diversified blend of industry east of Coldwater Creek
1225 single family
3 apartment complexes - 202 units
32 vacant lots--resid. zone
25 vacant lots--indus. zone
Population: 4607

No.	Classification	SIC Code	Building Area Sq Ft	No. of Employees
Auto Related				
4	Service Stations	5530	3,000	12
1	Auto Repair	7528	-	-
1	Auto Dealer	5516	3,000	4
Services				
1	Moving & Storage	4214	-	-
1	Shoe Repair	7251	450	1
1	Beauty Shop	7231	-	-
Retail				
1	Hardware	5251	3,000	3
4	Grocery Stores	5410	15,400	22
1	Retail Bakery	5461	800	5
1	Liquor Store	5920	1,600	3
1	Misc. Goods	5952	800	1
1	Drugstore	5910	3,800	5
1	Gift shop	5947	-	-
1	Resale Shop	-	-	-
Eating Establishments				
2	Rest.	5820	4,000	10

Professional: 1 chiropractor

Public Buildings: 1 church and school, 2 churches, 1 elementary school

Vacant Buildings: approx. 3 vacant buildings

Table 10 (Continued)

No.	Classification	SIC Code	Building Area Sq Ft	No. of Employees
Industry				
1	Wood Products	2499	5,417	7
1	Paperboard Containers	2650	140,800	125
1	Indus. Inorganic Chem.	2810	116,400	164
1	Printing, Publishing	2710	19,300	21
1	Misc. Chemical Prod.	2899	10,000	6
1	Misc. Petrol. Prod.	2991	122,800	110
1	Metal Products	3441	203,000	450
1	Metalworking Machinery	3543	10,000	16
1	Communications	4823	35,200	619
1	Warehouse--paper	5112	52,000	10
1	Alcoholic Bev. - Wholesale	5182	22,500	5
1	Misc. nondurable goods	5191	40,000	4
2	Misc. Goods--Paints, Varn.	5198	46,000	31
1	Misc. Goods	5199	5,000	5
13	Warehouses	4220	954,000	143

(Several other buildings were located on the maps but not on the printouts)

Figure 9 shows the land use and main streets in this area.

The Brown sampling area is characterized as pure industrial. There are no housing units, nor public/town buildings within this site area. There are only 3 commercial establishments which are home furnishing retail stores along No. Lindbergh Boulevard. Industry consists of 14 establishments, containing over 750,000 square feet and employing approximately 433 persons. Data summarizing the activities in the Brown area are given in Table 11.

8. Tap

The tap water samples were collected at the Coldwater Creek POTW.

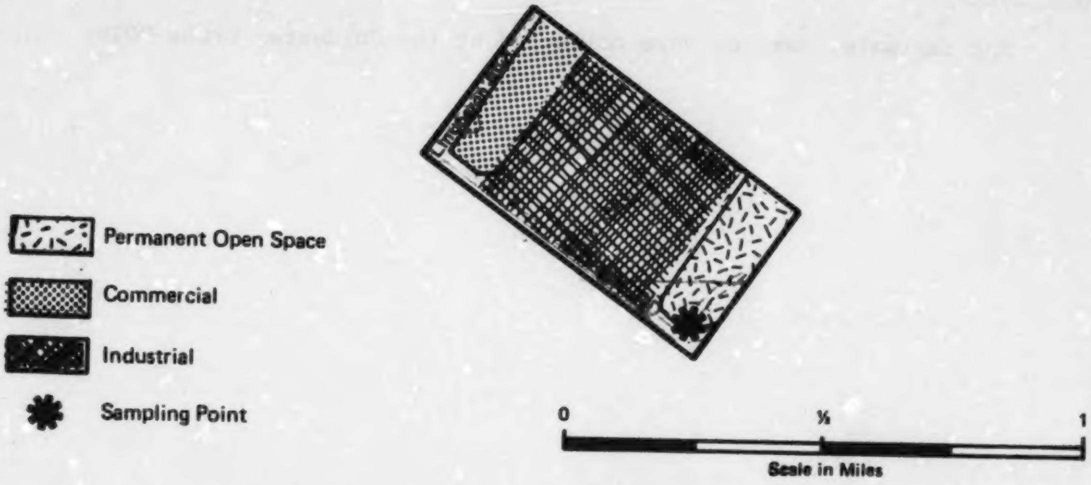

Permanent Open Space
Commercial
Industrial
Sampling Point
0
½
1
Scale in Miles

FIGURE 9 BROWN – LAND USE AND STREETS

Table 11

CHARACTERISTICS OF BROWN

industrial
no single family
1 vacant lot

No.	Classification	SIC Code	Building Area Sq Ft	No. of Employees
Auto Related				
1	Auto Dealer	5511	5,000	6
Retail				
1	Furniture, Home Furn.	5731	5,000	7
2	" "	5711	36,400+	14
Industry				
1	Millwork, Veneer, Plywood	2431	45,000	35
2	Petroleum Refining	2922	100,950	45
1	Tire & Rubber	301	18,000	19
1	Fab. Metals	3426	86,000	95
1	Secondary Smelting--Refin. of Nonferrous Metals	3340	300,000	150
2	Wholesale nondur. goods	5113	72,000	8
1	Wholesale nondur. goods	5197	10,000	8
1	Fuel dealer	5982	40,000	9
1	Wholesale nondur. goods	51	50,000	59
1	Fab. Metals	34	-	-
2	Misc. Manufac.	3999	30,000	5

IV. SAMPLING PROCEDURES

A. Sample Collection

For the most part, all aspects of the sample collection procedure used in St. Louis were comparable to those which had been used in the Cincinnati study.[3] As before, sample collection was performed utilizing a manual collection technique in which a two liter stainless steel graduate (bucket) was repeatedly lowered into the flow of wastewater to fill the required number of sample bottles.

Each sampling location was visited every four (4) hours and the six individual increments were composited to produce a single sample representing a 24-hour period. The increments were combined, in the laboratory, on a flow proportioned basis.

All of the field sampling procedures were the same as those employed in Cincinnati. Upon arriving at each sampling location, the field crew would first measure the temperature, pH, and oxidizing potential of the wastewater (with potassium-iodide starch paper) and then collect the required amount of wastewater as identified on a chart within the field sampling procedures manual (see Appendix A). The necessary volume of each sample increment was calculated to insure that adequate volume was collected each time to allow for accurate flow compositing over a daily variation ratio of three to one. Using this protocol, the final volume of wastewater collected was sufficient to produce a final "sample" that was made up of those fractions listed in Table 12.

After all of the sampling steps had been completed (including collection, labeling, preservation, clerical documentation, and packing), the volume of wastewater passing through the sampling location was determined. The depth of flow was measured and a flow measurement was obtained by using the Manning equation. All flow compositing of the collected sample increments was done using the flow rate computed in this way.

B. Flow Measurements

Initial flow calculations were made using the Manning equation approach, as had been done for Cincinnati. After completing all the field work, a review of the average flow rates for each of the sampling

Table 12

SUMMARY OF FINAL SAMPLE FRACTIONS AND THEIR REQUIRED VOLUMES

Priority Pollutants	Code	Normal Sample	QC'd Sample
• Acid/Base Neutral fraction	(ABN)	2L	6L
• PCB/Pesticide fraction	(PCB)	1L	3L
• Total Phenol fraction	(Phen)	1L	3L
• Cyanide fraction	(CN)	1L	3L
• Metal fraction	(M+)	1L	3L
• Mercury fraction	(Hg)	1L	3L
• Asbestos fraction	(As)	1L	3L
• Volatile Organic fraction	(VOA)	45mL	45mL
Classical Parameters			
• Ammonia	(NH_3)	1L	1L
• Chemical Oxygen Demand	(COD)	500mL	500mL
• Total Organic Carbon	(TOC)	500mL	500mL
• Biological Oxygen Demand	(BOD)	1L	1L
• Total Suspended Solids	(TSS)	1L	1L
• Oil and Grease	(O+G)	1L	1L

locations suggested that the values obtained were higher than could reasonably be expected. The basis of this belief lay in the fact that while the remote sampling sites accounted for roughly 15 to 20% of the basin's land mass, the measured flows apparently accounted for roughly 40% of the wastewater that was tributary to the Coldwater Creek treatment facility. Even though three of the selected sampling sites included industrial components which presumably use and discharge more water into collection systems than do comparably-sized residential zones, the possibility that these areas alone accounted for the disparity seemed remote.

In an attempt to determine whether the recorded values were, in fact, reasonable, a theoretical flow evaluation of each of the remote sites and the entire drainage basin was performed. The results of this analysis, compared with the initially tabulated, measured flows are reported in Table 13. The basis for compiling the theoretical flow values was comprised of two pieces. First, a listing of all commercial and industrial accounts existing within the Coldwater Creek basin on the date of November 1, 1977, was obtained, as well as a listing of their water consumption during the six-month period immediately preceding that date. By identifying which of these commercial and/or industrial accounts existed within each of the specified sampling areas, an estimate of their contribution to the total amount could be obtained. In addition, by knowing the population of a sampled zone, or the entire basin for that matter, and by multiplying that value by 100 gallons per day per person, which is the national average water consumption figure used in sewer design, an estimate of the flow attributable to residential sources can be derived. The sum of these three figures represents the total "theoretical flow" that could be expected to pass through a given point.

The data indicate that even though a good closure of the flow balance was attained for the entire basin, a poor ratio exists for many of the individual sampling sites. While it is possible that individual commercial and/or industrial accounts may have been incorrectly assigned during this analysis, these inaccuracies are not believed to be sufficient to greatly alter any of the "theoretical values."

Table 13

TOTAL THEORETICAL FLOW THROUGH EACH SAMPLING POINT IN ST. LOUIS

Calculated from MSD Billing Sheets for Commercial and Industrial
Assumes 100 gal/day/person for Residential Accounts

Location	Residential Units	Flow (LPS)	Commercial Units	Flow (LPS)	Industrial Units	Flow (LPS)	Calculated Total Flow	Measured Flow
Avocado (including Eppingham)	1649 single 382 apts	26.0 4.2	94/104 acc't for	2.1	0	0	32.3	40.2
Eppingham	641 single 382 apts	10.1 4.2	13/13 acc't for	0.2	0	0	14.5	23.1
Brightwell	425 single 6 apts	6.7 0.1	40/38 acc't for	0.3	0	0	7.1	11.9
Cross Keys	66 single 963 apts	1.0 10.5	73/75 acc't for	2.5	0	0	14.0	23.1
Brown	0 single 0 apts	0	4/4 acc't for	0.1	14/15 acc't for	4.5	4.6	12.2
Northwest	864 single 21 duplex 242 apts	13.6 0.7 2.6	69/170 acc't for	13.9	1/1 acc't for	0.0	30.8	105.3
Frost including Wabash	3025 single 4 duplex 246 apts	47.7 0.1 2.7	56/80 acc't for	0.7	48/51 acc't for	5.8	57.0	258.2
Wabash	1800 single 4 duplex 44 apts	28.4 0.1 0.5	45/57 acc't for	0.6	18/23 acc't for	1.3	30.9	57.4
Coldwater Creek	44,057 single 12,086 apts	827		103.4		125.2	1056	1022.0

Instead, it is believed that the Manning equation computation using the measured depth of flow values results in an erroneously high flow average

The Manning equation is presented below:

$$Q = \frac{\left[R^{2} \cos^{-1}\left(\frac{R - h}{R}\right) - (R - h)\sqrt{2Rh - h^{2}}\,\right]^{1.667} S^{0.5}}{\left[2R \cos^{-1}\left(\frac{R - h}{h}\right)\right]^{0.667} n}$$

where:

Q = volumetric flow rate (m^3/sec)
R = the radius of the pipe (m)
h = the measured water level from the bottom of the pipe (m)
S = slope of the pipe (m/m)
n = pipe roughness coefficient

It can be seen that the measurement or estimation of four variables (pipe radius, pipe slope, roughness, and depth of flow) have direct impact on the generated flow rate. In contrast to the experimentally measured depth of flow value, values for the other three variables are obtained either from sewer line construction plans (pipe diameter) and slope) or from reference book tabulations and are not directly verifiable. Any of these could be incorrect, which in turn would result in an inaccurate determination of the flow rate.

The values used for pipe slope and the roughness coefficients are of particular concern. A small difference in pipe slope (0.1%) could make as much as a 40% difference in the calculated flow rate. Comparably, the pipe roughness coefficient is known to vary considerably with increased (or decreased) depth of flow. For example, when depth of flow varies from 5% of full to 15% of full, the roughness coefficient increases by 8.5%.

To eliminate the effects of these two potentially variable values, the field depth of flow measurement was reevaluated. A detailed comparison of alternative flow measurement techniques carried out in Hartford, after the St. Louis study, showed that flow could be better measured by using a combination of depth and measured velocity.

Each of the sites studied in St. Louis was revisited to measure flow by the two alternative techniques and thus obtain a correction factor which could be applied to the original flow data. A velocity measurement of the flowing stream was made in conjunction with a depth of flow measurement. The velocity determination was then used directly with a wetted area value (derived geometrically from the known depth) to produce a value for the volumetric flow rate. As before, the depth of flow measurement was used in the Manning equation to produce a flow rate value. By ratioing these two values, the correction factor for each depth of flow measurement was obtained.

Since the calibration process was repeated at least four times during one 16-hour period, a wide range of flow values were averaged to produce the final "correction factor" for each of the specific sites. These correction factors were site specific and could be applied to all flow rates derived from the Manning equation in order to correct the reported values. The correction factors showed no trend dependent on total flow.

The original average flow rates, correction factors, final average flow rates, and theoretical flows are presented in Table 14 for review. The corrected values are in much better agreement with the theoretical values, and the summed portion of the basin sampled (217.8 Lps or 21.3%, excluding Eppingham and Wabash which are subsets of other sites) represents a reasonable percentage of the total basin when compared to the estimate derived from the percentage of land sampled.

Table 14

SUMMARY OF ST. LOUIS FLOW DATA

Location	Measured Flow Calculated by Manning Equation	Calculated Velocity to Manning Factor	"Corrected" Flow	Estimated Theoretical Flow
EPPINGHAM	23.1	0.687	15.9	14.5
AVOCADO	40.3	0.792	31.9	32.3
BRIGHTWELL	11.9	0.659	7.8	7.1
WABASH	57.4	1.560	89.5	30.9
CROSS KEYS	23.1	0.660	15.2	14.0
NORTHWEST	105.3	0.353	37.2	30.8
FROST	258.2	0.676 and 0.292	119.6	57.0
BROWN	12.2	0.501	6.1	4.6

V. CHEMICAL ANALYSIS

A. Chemical Procedures

1. Introduction

The procedures used to analyze samples collected in St. Louis are the same as those used for the Cincinnati samples. These procedures are described in the EPA Screening Protocol[1] and the Cincinnati Report.[3] Chemical analysis of the samples included preparation of a composite sample from the individual field samples, appropriate sample treatment (extraction, etc.), and subsequent instrumental analysis.

2. Modified Procedures

Some modifications were made in the procedures used to analyze priority pollutants in the base/neutral, pesticide, and metal categories in order to improve the analyses; these are summarized below. Details on all the analytical procedures are given in Appendix B.

a. Base/Neutrals

After sample preparation, the base/neutral extract was chromatographed onto a base deactivated methyl-phenyl silicone (Supelco's 3% SP 2250 DB)[5] gas chromatographic column interfaced with the GC/MS. This GC column was used rather than the methyl-phenyl silicone (Supelco's 1% SP 2250) GC column used for Cincinnati samples since improved chromatography of benzidine on the 3% SP 2250 DB GC column was reported by the EPA.[5]

b. Pesticides and PCBs

Prior to instrumental analysis, the pesticide and PCB extracts were spiked with an internal standard, tetrachlorotetrahydronaphthalene, to give a concentration of 0.4 ng/μL. The analytes were quantified with GC/ECD system (using peak areas relative to the internal standard) and a preliminary identification was obtained by comparing the retention times, relative to tetrachlorotetrahydronaphthalene, with the retention time of pesticide and PCB standards. The use of an internal standard for the first time with these samples improved the overall determination of recovery and precision.

An additional modification was the use of a second GC column, 2 mm I.D. glass column packed with Supelco 1.5% SP 2250/1.95% SP 2401, to corroborate the primary identifications. The retention times of the pesticides on this GC column were substantially longer. Any pesticides or PCBs tentatively identified on the two GC columns were confirmed using GC/MS techniques.

c. Metals

Seven of the metals (silver, chromium, copper, manganese, nickel, lead, and zinc) were analyzed using Direct Current Plasma Optical Emission Spectrometry (DCPOES), rather than flameless atomic adsorption spectroscopy which was used for the Cincinnati samples. Sample preparation for these analyses was identical to that outlined in the Cincinnati report[3] for flameless AA analysis except that the final samples contained 1000 ppm of lithium as an ionization buffer.

A Spectrospan III Plasma Emission Spectrometer (Spectrophysics, Inc., Andover, Massachusetts), equipped with a Spectrajet III, three-legged DC argon plasma excitation source, was used for all DCPOES analyses. Calibration standards were prepared by volumetric dilution of 1000 mg/L aqueous standard solutions (Spex Industries, Inc.) and addition of 1000 ppm lithium. Standards were analyzed before and after every two samples to correct for any instrument drift. The new reporting limits for the six metals analyzed by plasma emission spectroscopy were generally better than those obtained by flameless atomic adsorption spectroscopy and are tabulated in Appendix B.

3. Other Comments

Data on the field blanks can be found in Appendix B. The data indicate a general improvement in controlling contamination as compared with the Cincinnati data.

There were some compounds consistently not detected, using the EPA Screening Protocol.[1] These compounds are listed below. The only addition to the list presented in the Cincinnati report[3] is 2-chloroethyl vinyl ether. This compound was not available during the Cincinnati study. It is probably not being detected due to its volatility (b.p. 109°C) and subsequent loss during concentration of the extract, using the Kuderna-Danish technique.

STANDARDS NOT DETECTED BY THE EPA METHOD

Volatiles

- Chloromethane
- Bromomethane
- Vinyl Chloride
- Dichlorodifluoromethane

Base/Neutrals

- Bis-chloromethyl ether
- Hexachlorocyclopentadiene
- 2-Chloroethyl vinyl ether

Complete data from the chemical analyses have been tabulated by site location and chemical compound in Appendix D and Appendix E, respectively. The reporting limits for all the priority pollutants can be found in Appendix B.

B. Quality Assurance/Quality Control

1. Introduction

A quality assurance program was established for this study in order to document the reliability of the data obtained on the priority pollutants found in the samples. The quality control procedures used for the St. Louis study are detailed in the Cincinnati report.[3] The specific quality control (QC) activities for sample analysis were based on the general recommendations published by EMSL/EPA Cincinnati as specifically abstracted for this type of program in a March 1978 document.

The quality control (QC) data (recovery and precision) obtained from the St. Louis study were comparable to, or better than, the QC data from the Cincinnati study. The data for the metals analyzed by plasma emission spectroscopy, i.e., chromium, copper, lead, manganese, nickel, silver, and zinc, were substantially improved.

2. Program

For the field sampling trip in St. Louis, eight samples (from a range of source types) were chosen as quality control samples representing 12.5% of the total number of samples collected. The samples associated with the quality control activities are described in the Cincinnati Report[3] and are shown in Figure 10. A total of 92 samples were generated

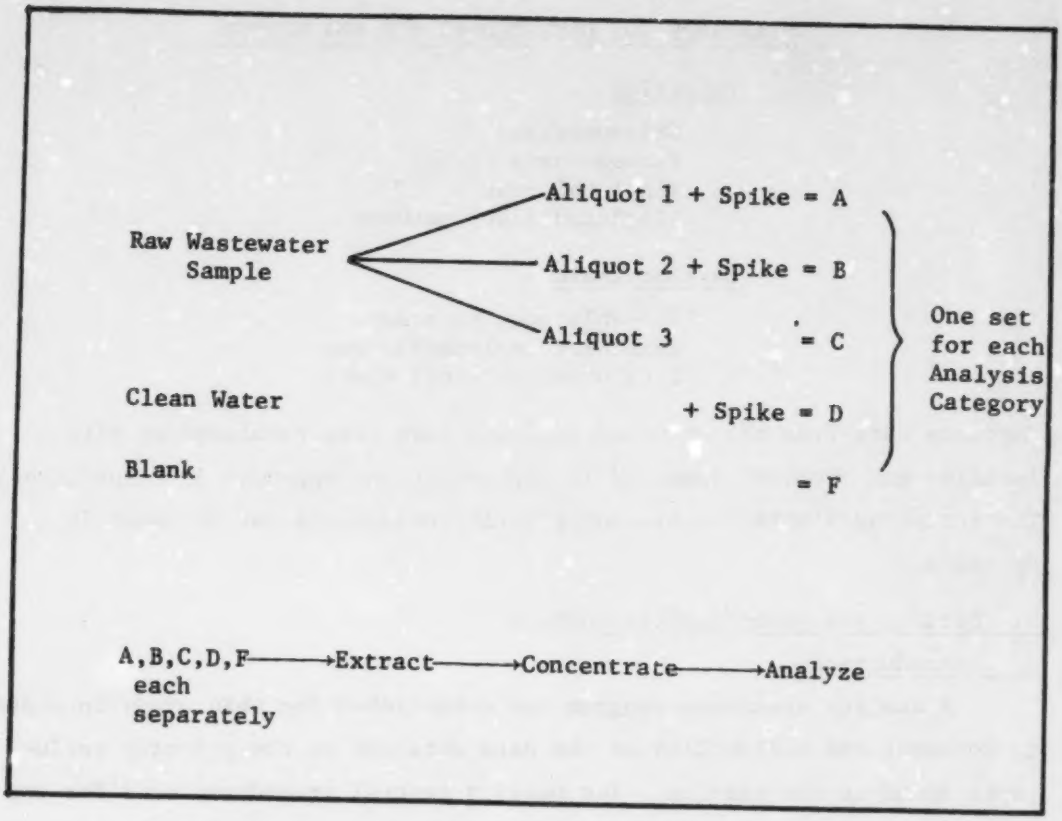

Raw Wastewater Sample
Aliquot 1 + Spike = A
Aliquot 2 + Spike = B
Aliquot 3 = C
One set for each Analysis Category
Clean Water
+ Spike = D
Blank
= F
A,B,C,D,F each separately
Extract
Concentrate
Analyze

Figure 10 DESCRIPTION OF QUALITY CONTROL SAMPLES

for analysis in the volatile acid and base/neutral categories; 28 of those 92 were QC samples and 2 were field blanks. Therefore, 33% of the samples analyzed were associated with the QC/QA program. For the pesticides, metals, total cyanides and total phenols, 34 of 96 samples (35%) were associated with the QC/QA program. Explanation of the symbols and data calculations used for the Quality Control Program are summarized in Appendix B.

Acceptable ranges for the recovery and precision data were based on the quality control data obtained from the Cincinnati study. The acceptable recovery ranges for method reference standards were based on the mean percent recovery calculated for the 15 Cincinnati QC samples, plus or minus twice the standard deviation. Acceptable recovery ranges for raw wastewater spikes were based on the mean percent recovery for the 30 Cincinnati QC samples, plus or minus three times the standard deviation. In addition, individual ranges, Ri, for the duplicate raw wastewater spikes were to be less than the established critical range, based on the 30 Cincinnati QC samples. Quality control charts were constructed from the Cincinnati QC data in order to determine that the St. Louis data was in control from day to day.

3. Results

The quantitative results for each pollutant studied are detailed in Appendix B and summarized briefly in this section. QC data were not obtained on five of the compounds [bis(2-chloroisopropyl)ether, indeno-(1,2,3-c,d)pyrene, endrin aldehyde, endosulfan sulfate, and 2,3,7,8-TCDD] because it was not possible to obtain reference supplies for these priority pollutants.

Because of the availability of the results from the detailed quality control program it was possible, for those few compounds for which the recommended protocol is problematic, to trace back to specific technical difficulties with the purge and trap apparatus or the chromatography. These problems are discussed in Appendix B.

For convenience in reviewing the data, Table 15 has been prepared summarizing the overall results achieved within each of the analysis

Table 15

SUMMARY OF QUALITY ASSURANCE DATA

		Cincinnati				St. Louis			
		Method Reference[a]		Raw Wastewater[a]		Methoa Reference[a]		Raw Wastewater [a]	
Category	Average Spiking Level, µg/L	Average Recovery	Average Standard Deviation	Average Recovery	Average Standard Deviation	Average Recovery	Average Standard Deviation	Average Recovery	Average Standard Deviation
Volatiles	20	87	±23	80	±31	±84[b]	16[b]	81[b]	±18[b]
Acids	50	89	±26	95	±22	75	±17	94	±19
Base/Neutrals	50	100	±33	84	±25	80	±17	75	±22
Pesticides and PCBs	30(Cinn.) 10(St.Louis)	73	±11	69	±14	78	±20	72	±19
Total Cyanides	20	103	± 3	101	±12	100	±9	96	±14
Total Phenols	60	107	±13	93	±15	87	±8	101	±14
Metals	10(Cinn.) 10 to 100(St.Louis)	115	±71	NA	±17	92	±9	102	±23

[a] Average of all mean percentage recovery values for each compound and average of all mean percentage recovery standard deviations for each compound.

[b] Methylene chloride data has been excluded.

[c] Metals data for Cincinnati cannot be directly compared with St. Louis since some of the analytical methods and spiking levels were changed. The precision for the raw wastewater spikes in Cincinnati was determined by using actual sample concentrations rather than recoveries due to the inappropriate spike levels.[3]

categories for Cincinnati and St. Louis QC samples. In general, these results are very good. Most recovery values are in the 80% to 90% range, and the precision is in the 10% to 30% range. The precision for the St. Louis study is generally improved compared to the Cincinnati study.

The spiking levels for two of the analytical categories--pesticides and PCBs, and metals--differed from the levels used for the Cincinnati study. The level at which the 14 pesticides were added to the QC samples was changed from 30 μg/L to 10 μg/L. Chlordane, toxaphene, and all the PCBs, except PCB-1254, were not included in the spiking solution; PCB-1254 was added to give a concentration level of 90 μg/L. For the Cincinnati study, the PCBs, chlordane, and toxaphene were added to give the same concentration level as the 14 pesticides. It was found that the method is not selective enough to detect the PCBs, chlordane, and toxaphene when present at the same concentration levels as the other pesticides. In actual samples, however, when compounds are not coeluting, there may be no problem detecting lower levels. It was experimentally determined that PCB-1254 could be analyzed at a concentration level of 90 μg/L without interfering with the other 14 pesticides or vice versa. The quality control results demonstrate that the precision and accuracy observed at pesticide concentration levels of 10 μg/L were comparable to the Cincinnati QC results at 30 μg/L.

The level at which 7 of the 14 priority pollutant metals were added to the QC samples was changed from that used for the Cincinnati study. In many cases, the spiking level used for the Cincinnati study was equal to or less than the detection limit. Further, several metals were found at levels significantly higher than the detection limit and/or spiking level. Therefore, as recommended in the Cincinnati Report,[3] those spiking levels were changed. Table 16 gives the new spiking levels as well as the levels used in the Cincinnati study. Plasma emission spectroscopy was the method of analysis for these metals rather than flameless atomic adsorption spectroscopy.

The quality control data obtained for these 7 metals in the St. Louis study were vastly improved in comparison to the Cincinnati data (see Table 17). In some cases, the precision was improved by an

Table 16

QUALITY CONTROL SPIKING LEVELS (μg/L) FOR METALS

	Cincinnati Spike	St. Louis Spike[a]	Procedure[b]
Silver	10	10	FAAS
Arsenic	10	25	FAAS
Beryllium	10	10	FAAS
Cadmium	10	10	FAAS
Chromium	10	100	PES
Copper	10	50	PES
Mercury	10	10	FAAS
Manganese	10	100	PES
Nickel	10	50	PES
Lead	10	50	PES
Antimony	10	10	FAAS
Selenium	10	10	FAAS
Thallium	10	10	FAAS
Zinc	10	100	PES

[a] Based on 5-10X detection limit and observed sample levels

[b] FAAS - Flameless atomic adsorption spectroscopy
PES - Plasma emission spectroscopy

Table 17

COMPARISON OF QUALITY ASSURANCE DATA

Metals

	CINCINNATI[a]				ST. LOUIS[b]			
	Method Ref. Std.		Raw Wastewater		Method Ref. Std.		Raw Wastewater	
Metals	Average % Recovery	Standard Deviation	Average % Recovery	Standard Deviation	Average % Recovery	Standard Deviation	Average % Recovery	Standard Deviation
505. Chromium	129	189	182	425	98	2	100	4
506. Copper	207	177	83	323	97	4	104	10
507. Lead	165	152	67	95	99	3	103	10
508. Manganese	143	98	185	143	100	.4	97	6
510. Nickel	74	96	0	436	102	3	104	6
512. Silver	108	30	90	21	93	9	114	23
514. Zinc	254	344	92	554	102	5	126	57

[a] Analyzed by Flameless Atomic Absorption Spectroscopy; Cincinnati spike levels were inappropriately low.

[b] Analyzed by Plasma Emission Spectroscopy.

order of magnitude. This improvement is attributable to appropriate spiking levels and use of the plamsa emission spectroscopy technique.

4. D_{10}-Anthracene

The internal standard, d_{10}-anthracene, for the acid and base/neutral analysis categories was added to the aqueous sample before extraction for both the Cincinnati and St. Louis studies in contrast to the normal procedure of adding it to the concentrated extract. The d_{10}-anthracene data were analyzed to determine whether or not this manner of adding the internal standard effects the recovery data reported. It was determined that d_{10}-anthracene was extracted with 95-100% efficiency and that the recoveries reported for the priority pollutants are valid as given and do not require any correction factor for comparison with other studies where d_{10}-anthracene is added to the extract. The results and procedures are given in Appendix C.

VI. DISCUSSION OF RESULTS

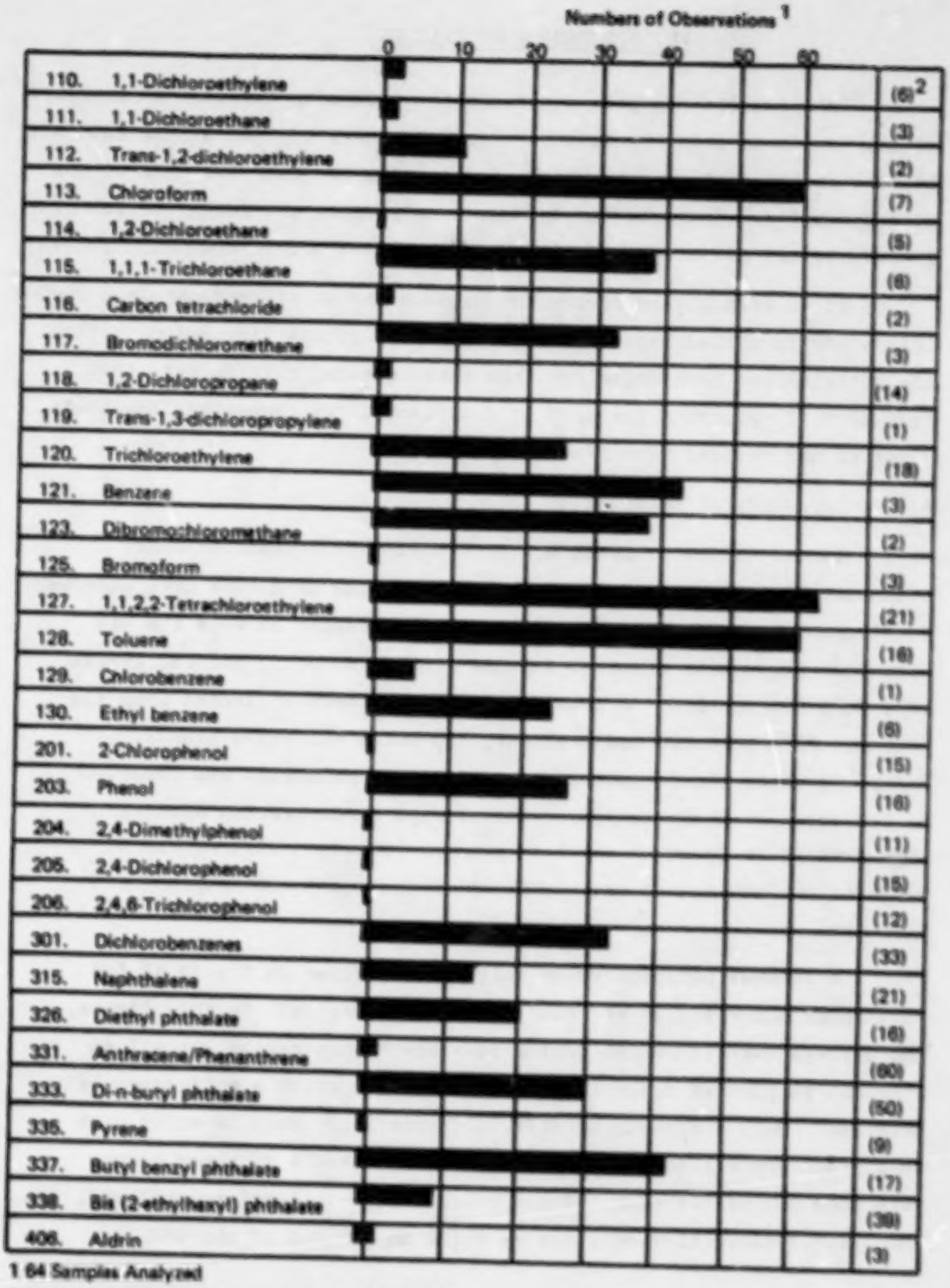
This section presents a discussion of results based on an analysis of the St. Louis data, by itself. Further interpretation of the data will be done in the final report which will examine the data from all of the cities studied. The detailed data used to prepare the summaries in this discussion are given in Appendices A (Flow Data) and D (Chemical Results).

It is possible to review the massive amount of data obtained during this study in myriad ways. For the purposes of this discussion section the material has been organized into three general categories: the frequency of detection (grouped by pollutant), the concentration levels observed and various mass flow analyses.

A. Frequency of Observation

In the Coldwater Creek drainage basin, 32 organic priority pollutants and 12 priority pollutant metals plus manganese were observed. Total cyanides and total phenols were also detected as were the six classical parameters measured in this study--ammonia, oil and grease, TSS, TOC, COD and BOD. A total of 64 samples were collected from the sources, POTW influent and effluent, tap water and field blanks. Figure 11 shows the frequency with which each pollutant was observed in the total of these samples. The average concentration measured when present is given in the last column. Nineteen (19) of the 47 observed pollutants are seen to occur at least 50% (32 samples) of the time.

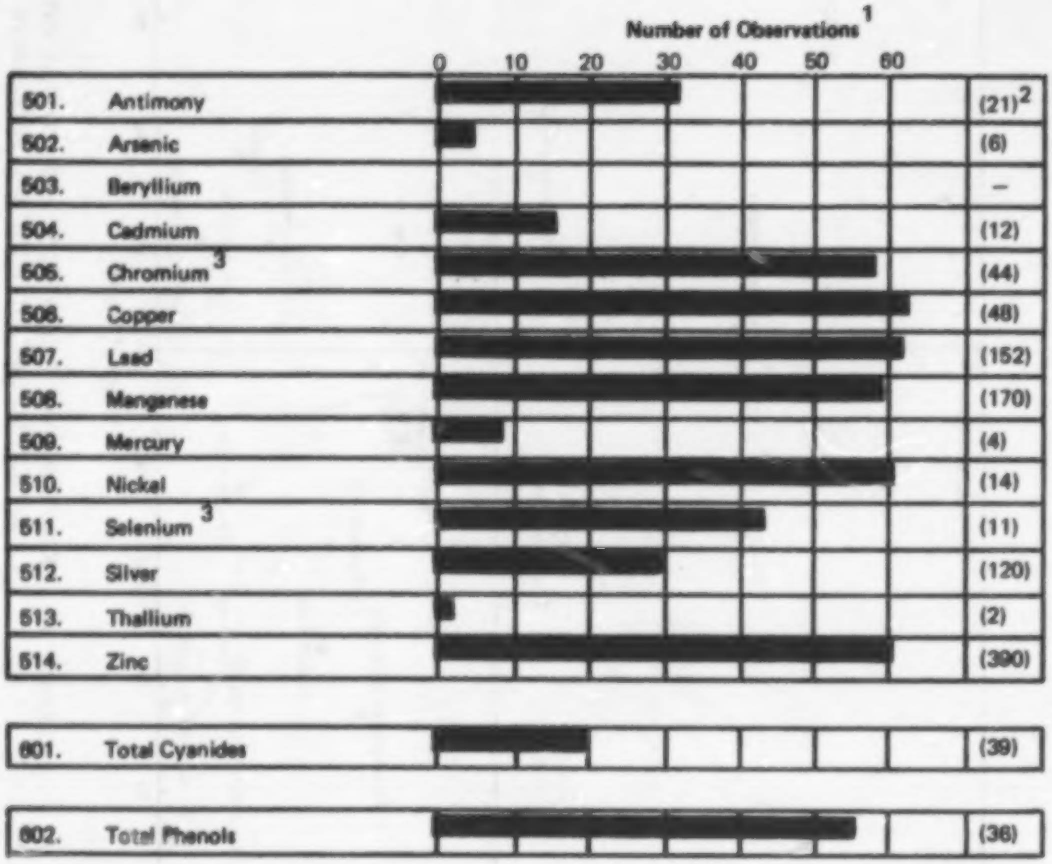
A further perspective on this data is given in Figure 12 for pollutants occurring in at least 10% of the samples. In this figure, the average overall concentration (average concentration for all 64 samples) is plotted against the frequency with which a pollutant was detected. Only 5 organic priority pollutants are seen to occur with an average concentration greater than 10 μg/L and 4 of these occur more than 50% of the time. Three pollutants -- chloroform, toluene, and 1,1,2,2-tetrachloroethylene -- occur in 90-100% of the samples.



1 64 Samples Analyzed

2 Average measured concentration (µg/L) in parentheses

Figure 11 FREQUENCY OF OBSERVATION OF PRIORITY POLLUTANTS



[1] 64 Samples Analyzed

[2] Average measured concentration (μg/L) in parentheses

[3] 63 Samples Analyzed

Figure 11 (continued) FREQUENCY OF OBSERVATION OF PRIORITY POLLUTANTS METALS, CYANIDES, AND PHENOLS

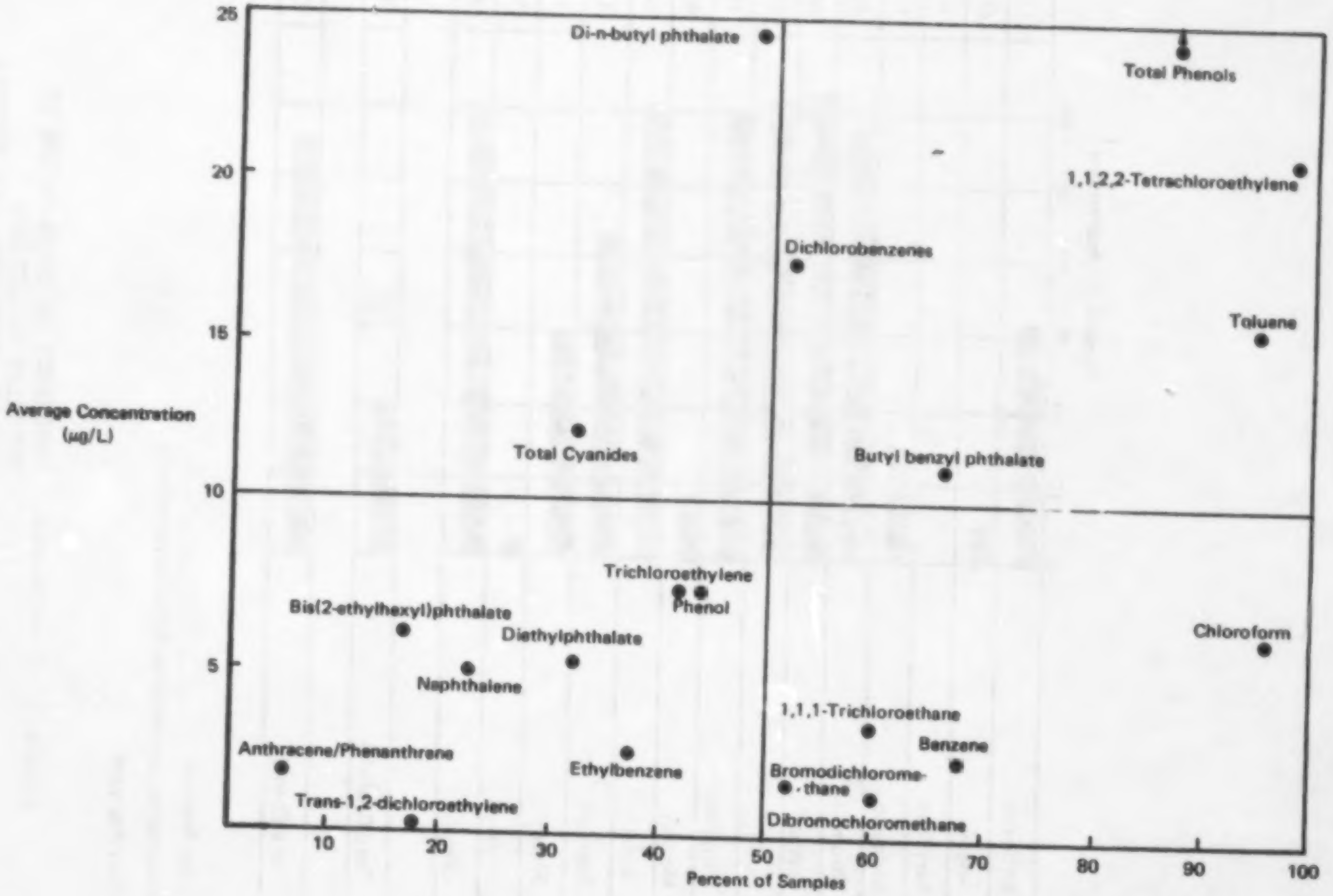


Figure 12 FREQUENCY OF OBSERVATION AND AVERAGE OVERALL CONCENTRATIONS OF PRIORITY POLLUTANTS

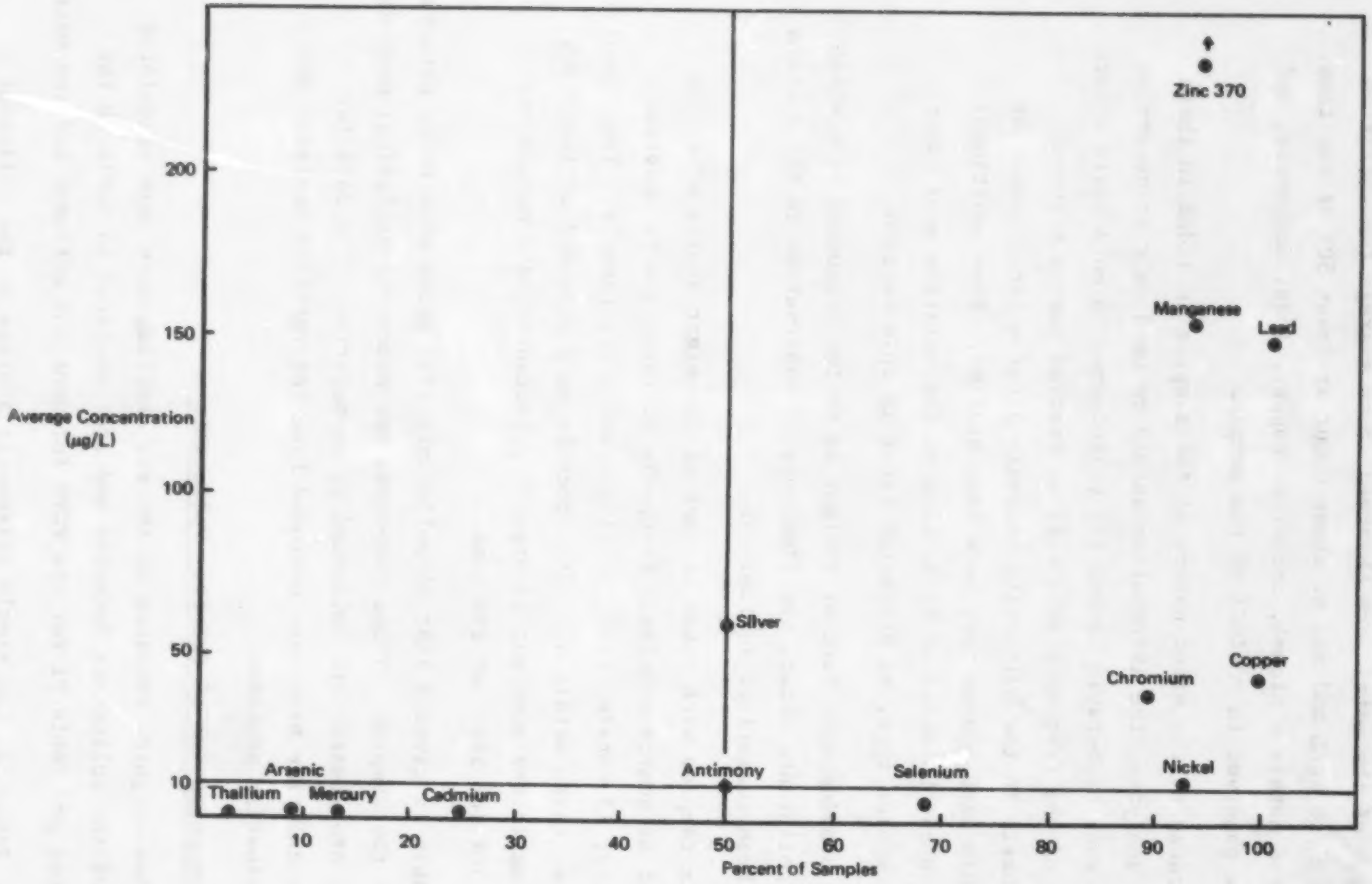


FIGURE 12 (continued) FREQUENCY OF OBSERVATION AND AVERAGE OVERALL CONCENTRATIONS OF PRIORITY POLLUTANTS

Eight of the metals are observed at an average concentration greater than 10 µg/L and all of these occur at least 50% of the time. Six of these metals - nickel, chromium, copper, lead, manganese, and zinc - are observed in 90-100% of the samples.

Because of the mixed nature of the samples included in these frequency analyses, the information should be used only to determine general trends of behavior among the pollutants. A more valid interpretation of the frequency data will be carried out on a source category basis in the multi-city analysis after a large number of sites within each source type have been studied. Some additional information can be obtained by looking at the relative mass contribution by source type, as presented later in this section.

To provide some further insight as to the frequency with which priority pollutants occur, the frequency of observation in the sources only has been summarized in Table 18.

Six samples were taken at each of the eight source sites for a total of 48 source samples. Forty-six pollutants were observed: 31 organics, 13 metals, total cyanides, and total phenols. Ten organic pollutants, seven metals and total phenols were observed at least 50% of the time in the sources; 14 organic pollutants and 2 metals were observed 10% (or less) of the time.

Table 19 gives a list of pollutants (79) which were never detected in any of the samples. Those compounds for which the analytical methods are still problematic are indicated by an asterisk. The data for methylene chloride have been excluded from interpretive analysis due to contamination problems.

B. Concentration of Priority Pollutants

Flow-weighted averages of the six sampling days were calculated for all of the pollutants detected and are tabulated in Table 20 for the sources and Table 21 for the POTW influent and effluent and tap water.

In Table 22, the simple arithmetic average of the pollutant concentrations for each of the source types has been presented, along with

Table 18

FREQUENCY ANALYSIS OF POLLUTANTS IN SOURCES ONLY

	# Observed	Percent	Avg. Concen. When Present	Avg. Overall Concentration
127 1,1,2,2-Tetrachloroethylene	48	100	21	21
128 Toluene	48	100	13	13
506 Copper	48	100	54	54
507 Lead	48	100	164	164
508 Manganese	48	100	169	169
510 Nickel	48	100	8.5	8.5
514 Zinc	48	100	443	443
113 Chloroform	47	98	6.9	6.7
505 Chromium	47	98	31	30
602 Total Phenols	47	98	35	34
337 Butyl benzyl phthalate	38	79	17	13
121 Benzene	35	73	2.3	1.6
511 Selenium	33	69	12	8
123 Dibromochloromethane	31	65	2.0	1.3
117 Bromodichloromethane	30	63	2.6	1.6
115 1,1,1-Trichloroethane	29	60	5.0	3.0
301 Dichlorobenzenes	29	60	33	20
203 Phenol	24	50	16	8
333 Di-n-butyl phthalate	23	48	62	30
130 Ethyl benzene	19	40	4.1	1.6
512 Silver	19	40	189	75
326 Diethyl phthalate	18	38	16	6
501 Antimony	18	38	11	4
120 Trichloroethylene	15	31	18	5.5
601 Total Cyanides	15	31	46	14
315 Naphthalene	11	23	23	5
504 Cadmium	10	21	15	3
509 Mercury	8	17	3.2	0.5
112 Trans-1,2-dichloroethylene	7	15	2.4	0.4
338 Bis(2-ethylhexyl)phthalate	7	15	51	7
129 Chlorobenzene	5	10	1.0	0.1
502 Arsenic	5	10	6.6	0.7
110 1,1-Dichloroethylene	2	4	6.5	0.3
116 Carbon Tetrachloride	2	4	1.5	0.1
118 1,2-Dichloropropane	2	4	13	0.6
119 Trans-1,2-dichloropropylene	2	4	1	0.04
406 Aldrin	2	4	2.5	0.1
513 Thallium	2	4	2.0	0.1
111 1,1-Dichloroethane	1	2	3.0	0.1
114 1,2-Dichloroethane	1	2	5.0	0.1
201 2-Chlorophenol	1	2	15	0.3
204 2,4-Dimethylphenol	1	2	11	0.2
205 2,4-Dichlorophenol	1	2	15	0.3
206 2,4,6-Trichlorophenol	1	2	12	0.3
331 Anthracene/Phenanthrene	1	2	107	2.2
335 Pyrene	1	2	2.5	0.1

Table 19

COMPOUNDS NOT DETECTED IN THE COLDWATER CREEK BASIN

101 Chloromethane*
102 Dichlorodifluoremethane*
103 Bromomethane*
104 Vinyl chloride*
105 Chloroethane*
107 Acrolein
108 Trichlorofluoromethane
109 Acrylonitrile
122 Cis-1,3-dichloropropylene
124 1,1,2-Trichloroethane
126 1,1,2,2-Tetrachloroethane
202 2-Nitrophenol
207 4-Chloro-3-cresol
208 2,4-dinitrophenol
209 4,6-dinitro-2-cresol
210 Pentachlorophenol
211 4-Nitrophenol
304 Hexachloroethane
305 Bis(chloromethyl)ether*
306 Bis(2-chloroethyl)ether
307 Bis(2-chloroisopropyl)ether
308 N-Nitrosodimethylamine**
309 Nitrosodi-n-propylamine
310 Nitrobenzene
311 Hexachlorobutadiene
312 1,2,4-Trichlorobenzene
313 2-Chloroethyl vinyl ether*
314 Bis(2-chloroethoxy)methane
316 Isophorone
317 Hexachlorocyclopentadiene*
318 2-Chloronaphthalene
319 Acenaphthylene
320 Acenaphthene
321 Dimethyl phthalate
322 2,6-Dinitrotoluene
323 4-Chlorophenyl phenyl ether
324 Fluorene
325 2,4-Dinitrotoluene
327 1,2-Diphenylhydrazine
328 N-Nitrosodiphenylamine
329 Hexachlorobenzene
330 4-Bromophenyl phenyl ether
334 Fluoranthene
336 Benzidine**
340 Chrysene/Benzo(a)anthracene
342 3,3'-Dichlorobenzidine
343 Benzofluoranthenes
345 Benzo(a)pyrene
346 Indeno(1,2,3-c,d)pyrene
347 Dibenzo(a,h)Anthracene
348 Benzo(g,h,i)perylene
349 TCDD
401 alpha-BHC
402 gamma-BHC
403 Heptachlor
404 beta-BHC
405 delta-BHC
407 Heptachlor epoxide
408 Endosulfan I.
409 DDE
410 Dieldrin
411 Endrin
412 DDD
413 Endosulfan II
414 DDT
415 Endrin aldehyde
416 Endosulfan sulfate
417 Chlordane
418 Toxaphene
419 PCB-1221
420 PCB-1232
421 PCB-1242
422 PCB-1248
423 PCB-1254
424 PCB-1260
425 PCB-1016
503 Beryllium

* These compounds are not detected using the EPA Screening Protocol.

** Problems encountered during analysis.

Table 20

FLOW-WEIGHTED CONCENTRATION AVERAGES (μg/L)

ORGANICS

COMPOUND	EPPINGHAM res.	AVOCADO res.	BRIGHTWELL res.	WABASH mixed	CROSS KEYS comm.	NORTHWEST comm.	FROST ind.	BROWN ind.
110. 1,1-Dichloroethylene	-	-	-	-	1	0.8	-	-
111. 1,1-Dichloroethane	-	-	-	-	-	0.5	-	-
112. Trans-1,2-dichloroethylene	-	-	-	0.3	3	-	0.2	-
113. Chloroform	3	3	3	6	6	6	20	7
114. 1,2-Dichloroethane	-	-	0.7	-	-	-	-	-
115. 1,1,1-Trichloroethane	5	0.6	1	3	0.8	10	8	-
116. Carbon tetrachloride	-	-	-	-	-	-	0.5	-
117. Bromodichloromethane	-	-	0.3	2	3	2	2	4
118. 1,2-Dichloropropane	-	-	-	5	-	-	-	-
119. Trans-1,3-dichloropropylene	-	-	-	0.2	-	0.2	-	-
120. Trichloroethylene	-	2	0.3	-	-	-	23	19
121. Benzene	0.7	0.2	2	3	1	5	2	0.6
123. Dibromochloromethane	-	-	0.3	2	2	2	2	3
125. Bromoform	-	-	-	-	-	-	-	-
127. 1,1,2,2-Tetrachloroethylene	21	15	16	15	45	21	17	14
128. Toluene	2	5	12	7	6	24	5	30
129. Chlorobenzene	-	-	0.3	0.2	-	0.4	-	-
130. Ethyl benzene	-	-	3	0.2	0.2	4	0.5	2
201. 2-Chlorophenol	-	-	-	-	-	-	3	-
203. Phenol	2	15	6	23	6	4	7	-
204. 2,4-Dimethylphenol	-	2	-	-	-	-	-	-
205. 2,4-Dichlorophenol	-	-	-	-	-	-	3	-
206. 2,4,6-Trichlorophenol	-	-	-	-	-	-	2	-
301. Dichlorobenzenes	-	13	20	32	26	23	28	17
315. Naphthalene	-	-	19	-	-	5	9	11
326. Diethyl phthalate	13	11	3	2	12	5	-	-
331. Anthracene/Phenanthrene	-	-	18	-	-	-	-	-
333. Di-n-butyl phthalate	9	24	7	6	5	16	Ɛ1	99
335. Pyrene	-	-	2	-	-	-	-	-
337. Butyl benzyl phthalate	13	12	25	9	16	14	18	0.9
338. Bis (2-ethylhexyl) phthalate	3	-	46	2	4	4	-	-
406. Aldrin	-	0.8	-	-	-	-	-	-

Table 20 (cont'd.)

FLOW-WEIGHTED CONCENTRATION AVERAGES (μg/L)
METALS, CYANIDES, AND PHENOLS

	COMPOUND	EPPINGHAM res.	AVOCADO res.	BRIGHTWELL res.	WABASH mixed	CROSS KEYS comm.	NORTHWEST comm.	FROST ind.	BROWN ind.
501.	Antimony	13	12	-	-	-	-	9	-
502.	Arsenic	-	-	-	-	-	-	-	6
503.	Beryllium	-	-	-	-	-	-	-	-
504.	Cadmium	1	1	6	3	-	-	11	4
505.	Chromium	11	8	10	31	7	21	134	18
506.	Copper	31	36	139	52	42	32	71	42
507.	Lead	55	55	792	84	87	89	96	78
508.	Manganese	199	220	107	201	92	270	205	61
509.	Mercury	0.5	2	0.9	-	0.7	0.5	-	-
510.	Nickel	10	8	10	9	8	8	10	6
511.	Selenium	8	14	9	11	18	0.7	3	4
512.	Silver	5	11	0.7	0.8	1	4	3	567
513.	Thallium	-	-	-	0.4	-	-	0.3	-
514.	Zinc	103	97	1209	1266	115	76	652	122
601.	Total Cyanides	-	-	2	51	-	2	56	2
602.	Total Phenols	36	41	37	44	32	31	29	28

Table 20 (cont'd.)

FLOW-WEIGHTED CONCENTRATION AVERAGES (mg/L) CLASSICAL PARAMETERS

SAMPLE NUMBER	EPPINGHAM res.	AVOCADO res.	BRIGHTWELL res.	WABASH mixed	CROSS KEYS comm.	NORTHWEST comm.	FROST ind.	BROWN ind.
pH	7.1	7.0	7.1	7.2	7.0	7.0	7.6	7.6
T (°C)	17.0	17.1	16.8	15.7	18.0	17.0	15.8	15.0
Ammonia	16	21	17	12	9	10	11	21
Oil and Grease	42	54	490	33	49	41	22	6
TSS	102	134	148	78	114	84	97	48
TOC	90	125	110	79	91	111	80	38
COD	195	293	310	209	233	218	193	144
BOD	116	184	160	101	143	187	70	47

Table 21

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L) ORGANICS

COMPOUND	TAP WATER		POTW INF		POTW EFF
110. 1,1-Dichloroethylene	–		0.8		–
111. 1,1-Dichloroethane	–		0.3		–
112. Trans-1,2-dichloroethylene	–		0.5		–
113. Chloroform	21		6		2
114. 1,2-Dichloroethane	–		–		–
115. 1,1,1-Trichloroethane	–		9		1
116. Carbon tetrachloride	–		–		–
117. Bromodichloromethane	13		0.7		–
118. 1,2-Dichloropropane	–		–		–
119. Trans-1,3-dichloropropylene	–		–		–
120. Trichloroethylene	–		29		5
121. Benzene	–		7		4
123. Dibromochloromethane	8		1		0.3
125. Bromoform	2		–		–
127. 1,1,2,2-Tetrachloroethylene	2		45		10
128. Toluene	1		60		2
129. Chlorobenzene	–		0.2		–
130. Ethyl benzene	–		16		1
201. 2-Chlorophenol	–		–		–
203. Phenol	–		11		–
204. 2,4-Dimethylphenol	–		–		–
205. 2,4-Dichlorophenol	–		–		–
206. 2,4,6-Trichlorophenol	–		–		–
301. Dichlorobenzenes	–		26		–
315. Naphthalene	–		10		–
326. Diethyl phthalate	–		7		–
331. Anthracene/Phenanthrene	–		–		2
333. Di-n-butyl phthalate	–		16		2
335. Pyrene	–		–		–
337. Butyl benzyl phthalate	–		11		–
338. Bis (2-ethylhexyl) phthalate	–		4		–
406. Aldrin	–		–		–

Table 21 (cont'd.)

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
METALS, CYANIDES, AND PHENOLS

COMPOUND		TAP WATER		POTW INF		POTW EFF
501.	Antimony	12		53		23
502.	Arsenic	–		–		–
503.	Beryllium	–		–		–
504.	Cadmium	–		3		0.8
505.	Chromium	–		136		61
506.	Copper	7		47		14
507.	Lead	29		210		60
508.	Manganese	–		202		144
509.	Mercury	–		0.5		–
510.	Nickel	–		46		33
511.	Selenium	8		4		6
512.	Silver	–		16		13
513.	Thallium	–		–		–
514.	Zinc	15		290		96
601.	Total Cyanides	–		15		–
602.	Total Phenols	–		61		9

Table 21 (cont'd.)

CLASSICAL WASTEWATER PARAMETER ANALYSIS (mg/L)

	TAP WATER		POTW INF		POTW EFF
pH	8.2		7.0		7.0
T (^{o}C)	20.4		18.6		17.4
Ammonia	0.5		17		16
Oil and Grease	-		31		0.8
TSS	-		125		18
TOC	8		97		26
COD	-		306		68
BOD	-		155		18

Table 22

ST. LOUIS AVERAGE CONCENTRATIONS BY SOURCE TYPE

(micrograms per liter)*

		New Residential	Old Residential	Commerce	Industry	Tap Water	Influent
112	Trans-1,2-Dichloroethylene	0	0	1	0	0	1
113	Chloroform	3	5	6	13	21	6
115	1,1,1-Thochloroethane	2	2	6	4	0	9
117	Bromodichloromethane	0	1	2	3	13	1
120	Trichloroethylene	1	0	0	21	0	29
121	Benzene	0	2	3	1	0	7
123	Dibromochloromethane	0	1	2	2	8	1
127	1,1,2,2-Tetrachloroethylene	18	15	33	17	2	45
128	Toluene	4	9	15	23	1	60
130	Ethyl Benzene	0	2	3	2	0	13
203	Phenol	8	15	5	4	0	11
301	Dichlorobenzenes	7	27	24	22	0	26
315	Naphthalene	0	9	2	10	0	10
326	Diethyl Phthalate	13	3	9	0	0	7
333	Di-N-Butyl Phthalate	15	7	11	87	0	16
337	Butyl Benzyl Phthalate	12	17	15	10	0	11
338	Bis(2-Ethylhexy) Phthalate	1	25	4	0	0	4
501	Antimony	12	0	0	5	12	53
504	Cadmium	2	5	1	9	0	3
505	Chromium	9	21	16	76	2	136
506	Copper	33	92	37	56	7	47
507	Lead	55	427	88	88	29	210
508	Manganese	208	154	180	133	0	202
509	Mercury	2	1	1	0	1	1
510	Nickel	9	9	8	8	2	46
511	Selenium	11	10	10	2	8	5
512	Silver	8	1	3	290	0	16
514	Zinc	101	1192	96	385	15	290
601	Total Cyanides	0	27	1	30	0	15
602	Total Phenols	37	40	32	28	0	61
703	Ammonia	19	14	15	16	0	17
704	Oil and Grease	49	245	45	14	0	31
705	TSS	117	111	98	70	0	125
706	TOC	105	94	100	58	8	97
707	COD	250	258	227	169	0	306
708	BOD	147	128	165	57	0	155
	Number of sites	2	2	2	2	-	-
	Number of samples	12	12	12	12	2	6

*classicals in mg/L

the tap water and influent, as an aid to discover the patterns that may be present in the concentration data. Only those chemicals which were observed in more than 10% of the samples are included in this summary. It is recognized that the concentration data by themselves do not provide the basis for estimating POTW influent values, but they are useful in observing the differences in chemical activity among the sites.

Many of the pollutants do not show any strong concentration differences between source types. Di-n-butyl phthalate has the greatest intensity at the industrial sources. Phenol shows a tendency to be most concentrated in the residential sources. Trichloroethylene was most intense in the industrial sources. Silver is most concentrated at the industrial sites, and a review by SIC category of the industries present at those sites indicates a 150 employee non-ferrous metals smelting plant as a possible source. Chromium was also highest at the industrial sites. Lead and zinc were present at highest concentrations in the old residential sites suggesting the plumbing as a possible source of those pollutants.

As mentioned, the concentration data only provide certain clues as to possible particular sources of pollutants. They also provide a perspective on the matter of whether pollutants observed at the POTW are also observed in the sources and vice versa.

The most complete analysis of this data is performed when the flow and concentration data are combined to project a total mass flow.

C. Mass Balance Analysis

1. Calculations for Total Basin Scale-up

One of the objectives of this study is to be able to predict the relative mass contribution to POTW influents of residential and commercial sources, in particular, in order to be able to subtract out pollutant loads due to these sectors and estimate the industrial contribution at any given POTW after measurement of the influent. The total mass flow to the POTW for any pollutant may be expressed as

$$\text{POTW} = \text{RES} + \text{COM} + \text{IND}$$

representing the total mass flow (e.g., in Kg/day) to the POTW from each of the three major source categories. Thus, for any new city, Q, if the total contribution from the residential and commercial sources can be estimated, then the industrial contribution can be calculated after measuring the POTW as follows:

$$IND_Q = POTW_Q - (RES_Q + COM_Q)$$

One means of checking the validity of the data, as it is being developed, is to carry out a mass balance calculation for the city (x) being studied by adding the relative contributions from each source type for comparison with the POTW:

$$POTW_x = RES_x + COM_x + IND_x$$

These goals could be attained if it were possible to determine an average index value (V) for each source category which could be scaled up for each POTW basin according to the relative amount of each type of source activity in the basin (A). In the general case, the equation would take the form

$$POTW = V_R \cdot A_R + V_C \cdot A_C + V_I \cdot A_I$$

indicating the quantities of each source type (R = RES, C = COM, I = IND).

The basic data available from each sampling site to use in developing this approach is concentration, flow and population. For the POTW drainage basin as a whole, it is usually possible to obtain reliable estimates of total population (from the land planning agency) and total commercial and industrial flow (from the water use records).

For the residential sites, it is reasonable to use the population as an index basis. Thus, for the residential sites, a per capita discharge rate can be calculated as follows:

$$\text{mass/person/day} = \frac{\text{concentration} \cdot \text{flow}}{\text{population}}$$

For reporting convenience, the residential values have been developed in units of mg/person/day. The total basin residential contribution may thus be estimated as

$$\text{RES(Kg/day)} = \text{Res.Avg.(mg/person/day)} \cdot \text{Basin Population} \cdot 0.0864$$

For the commercial and industrial sites, the only index reliably available for all of the sites studied (and the basin) is the total flow.

Thus, for these source types an average concentration value has been calculated so that, when the average value is multiplied by the total basin source type flow, the total source contribution is obtained:

$$\text{COM}(\text{K}_g/\text{day}) = [\text{Avg.Com.Conc.}(\mu g/L)] \cdot [\text{Com.Flow}(L/sec)] \cdot 8.64 \times 10^{-5}$$

$$\text{IND}(\text{K}_g/\text{day}) = [\text{Avg.Ind.Conc.}(\mu g/L)] \cdot [\text{Ind.Flow}(L/sec)] \cdot 8.64 \times 10^{-5}$$

The data obtained from the commercial sites do not show a wide range in type or quantity of pollutant between sites and suggests that an average commercial concentration is a valid concept. To the contrary, the industrial site data show a wide range of both types and concentration of pollutant indicating that an average industrial concentration is not a valid concept which can be applied generally. It is useful, however, within a basin to calculate this value so that a mass balance comparison between the sources and POTW may be made. Such a comparison provides a test of how well the sites sampled represent the quantity and qualitative nature of the whole of that source type within the basin.

Table 23 summarizes the basic characteristics of each of the sampling sites, giving the relative flow contribution from the three main source types, population, and average measured flow.

The per capita mass discharge rates calculated for each of the residential sources are shown in Table 24 along with the population weighted average value. The average concentration values, calculated on a straight average basis, for the commercial and industrial sources, are given in Table 25. These tables include those chemicals observed in more than 10% of the samples.

The average index values may be used, from the approach discussed above, to calculate the total mass flow from each of the source types within the drainage basin according to the equation below:

$$\text{Sum} = \text{RES} \cdot \text{Population} + \text{COM} \cdot \text{Flow}_C + \text{IND} \cdot \text{Flow}_I$$

where RES, COM and IND indicate the average value either on a per capita or concentration basis, population refers to the total drainage basin

Table 23

SUMMARY OF SITE CHARACTERISTICS

Name of Site	Designation	Relative % Flow[a]			Population	Average Measured Flow (Lps)
		RES	COM	IND		
Eppingham	New Residential	98.6	1.4	0	3,300	15.9
Avocado	New Residential	93.5	6.5	0	6,929	31.9
Brightwell	Old Residential	95.8	4.2	0	1,545	7.8
Wabash	Mixed	93.9	1.9	4.2	6,615	89.5
Cross Keys	Commercial	82.1	17.9	0	2,124	15.2
Northwest	Commercial	54.9	45.1	0	3,160	37.2
Frost	Industrial	88.6	1.2	10.2	11,222	119.6
Brown	Industrial	0	2.2	97.8	0	6.1
POTW Influent	POTW/Basin	78.3	9.8	11.9	200,000	1022
POTW Effluent	POTW/Basin					989

a. Based on theoretical flow analysis

Table 24

RESIDENTIAL SOURCE PER CAPITA VALUES

mg/person/day*

	Priority Pollutant	Eppingham	Avocado	Brightwell	Weighted Average
112	Trans-1,2-Dichloroethylene	.00	.00	.00	.00
113	Chloroform	1.19	1.33	1.43	1.31
115	1,1,1-Trichloroethane	1.93	.26	.53	.76
117	Bromodichloromethane	.00	.00	.14	.02
120	Trichloroethylene	.00	.62	.14	.38
121	Benzene	.30	.06	.66	.21
123	Dibromochloromethane	.00	.00	.14	.02
127	1,1,2,2-Tetrachloroethylene	8.86	5.95	6.93	6.89
128	Toluene	.89	2.15	5.21	2.20
130	Ethyl Benzene	.00	.00	1.48	.19
203	Phenol	.85	6.13	2.72	4.21
301	Dichlorobenzenes	.00	5.10	8.88	4.17
315	Naphthalene	.00	.00	8.38	1.10
326	Diethyl Phthalate	5.54	4.50	1.47	4.39
333	Di-N-Butyl Phthalate	3.54	9.48	3.12	6.98
337	Butyl Benzyl Phthalate	5.48	4.73	10.79	5.73
338	Bis(2-Ethylhexyl)Phthalate	1.19	.00	20.23	2.99
501	Antimony	5.23	4.94	.00	4.38
504	Cadmium	.58	.40	2.72	.75
505	Chromium	4.38	3.02	4.49	3.60
506	Copper	12.83	14.10	60.90	19.88
507	Lead	22.97	21.69	346.24	64.64
508	Manganese	82.67	87.29	46.91	80.70
509	Mercury	.22	.82	.39	.60
510	Nickel	4.07	3.20	4.42	3.60
511	Selenium	3.25	5.45	3.84	4.62
512	Silver	1.91	4.54	.30	3.25
514	Zinc	42.69	38.64	531.23	104.42
601	Total Cyanides	.00	.00	.86	.11
602	Total Phenols	14.82	16.27	16.23	15.86
703	Ammonia	6.72	8.42	7.26	7.79
704	Oil and Grease	17.25	21.51	214.10	45.59
705	TSS	42.30	53.20	64.55	51.64
706	TOC	37.41	49.55	48.07	45.95
707	COD	80.80	116.31	135.58	108.88
708	BOD	48.15	72.99	69.91	65.63

*classicals in kg/person/day

Table 25

AVERAGE COMMERCIAL AND INDUSTRIAL CONCENTRATION VALUES

		µg/L*	
	Priority Pollutant	Commercial	Industrial
112	Trans-1,2-Dichloroethylene	1.3	.1
113	Chloroform	6.1	13.2
115	1,1,1-Trichloroethane	5.6	4.1
117	Bromodichloromethane	2.2	3.2
120	Trichloroethylene	.0	20.9
121	Benzene	2.8	1.3
123	Dibromochloromethane	1.7	2.3
127	1,1,2,2-Tetrachloroethylene	33.1	15.8
128	Toluene	15.2	17.5
130	Ethyl Benzene	1.9	1.2
203	Phenol	5.2	3.6
301	Dichlorobenzenes	24.4	22.1
315	Naphthalene	2.3	10.3
326	Diethyl Phthalate	8.7	.0
333	Di-N-Butyl Phthalate	10.2	89.8
337	Butyl Benzyl Phthalate	14.9	9.3
338	Bis(2-Ethylhexyl)Phthalate	4.3	.0
501	Antimony	.0	4.4
504	Cadmium	.0	7.4
505	Chromium	13.8	76.3
506	Copper	36.9	56.1
507	Lead	87.7	87.1
508	Manganese	180.3	132.6
509	Mercury	.6	.0
510	Nickel	7.6	8.1
511	Selenium	9.4	1.7
512	Silver	2.3	285.0
514	Zinc	95.2	387.4
601	Total Cyanides	.9	28.9
602	Total Phenols	31.3	27.4
703	Ammonia	9.3	15.9
704	Oil and Grease	45.1	13.6
705	TSS	99.0	72.7
706	TOC	100.8	59.1
707	COD	225.8	168.4
708	BOD	165.5	58.6

*classicals in mg/L

population, and $Flow_C$ and $Flow_I$ are, respectively, the total commercial and industrial flows in the basin. The values thus calculated may be compared with the POTW influent as shown in Table 26.

The data in Table 26 are grouped according to those pollutants whose SUM matches the POTW influent (INF), those that are higher in the influent than projected from the sum of the sources, and those that are higher in the sources than observed in the influent. For convenience, the mass values are expressed in Kg/day, except for the classicals, which are in 10^3 Kg/day.

It has been estimated that the combined uncertainty in each of the source concentration and flow measurements, as well as in the pair of influent measurements, amounts to about a factor of two. That is, in making comparisons between SUM and INF within the error limits of the analysis, pollutants for which the INF/SUM ratios fall in the range of 0.5-2.0 are considered to have agreement between their projected source total (SUM) and the POTW influent (INF).

The usefulness of this mass balance analysis is primarily in evaluating how well the sources sampled represent the total source distribution in the basin and in providing a measure of the reliability in using the individual index values in the overall multi-city evaluation.

Some of the INF/SUM ratios in Table 26 are shown in parentheses ( ) to indicate that the INF value is probably too low to allow for a meaningful comparison. The significance of the influent measurement has been determined with respect to the reporting limit of the pollutant in question. A value of 0.088 Kg/day at the influent flow of 1022 LpS corresponds to a concentration of 1 μg/L; 0.88 Kg/day equals 10 μg/L. Of these 30 priority pollutants, 14 are accounted for by a projection of the sources. Of the 25 priority pollutants with significant quantity (mass flow corresponding to an average concentration greater than the reporting limit), 11 of these are accounted for by the sources sampled. Five of the six classical parameters are accounted for by the sources.

Table 26

MASS BALANCE ANALYSIS

				Kg/Day*			
		RES	COM	IND	SUM	INF	INF/SUM
	Compounds whose influent value is within 0.5-2.0 times the calculated sum						
113	Chloroform	0.26	0.05	0.14	0.45	0.54	1.2
117	Bromodichloromethane	0.00	0.02	0.03	0.06	0.06	(1.0)
203	Phenol	0.84	0.04	0.04	0.92	0.93	1.0
301	Dichlorobenzenes	0.83	0.21	0.23	1.28	2.30	1.8
326	Diethyl Phthalate	0.88	0.08	0.00	0.95	0.62	(0.6)
333	Di-n-butyl Phthalate	1.40	0.09	0.94	2.43	1.40	0.6
337	Butyl Benzyl Phthalate	1.15	0.13	0.10	1.37	1.00	0.7
338	Bis(2-ethyl hexyl)phthalate	0.60	0.04	0.00	0.63	0.38	(0.6)
504	Cadmium	0.15	0.00	0.08	0.23	0.26	1.1
506	Copper	3.98	0.32	0.59	4.89	4.11	0.8
507	Lead	12.93	0.76	0.92	14.60	18.56	1.3
508	Manganese	16.14	1.56	1.39	19.09	17.79	0.9
514	Zinc	20.88	0.82	4.07	25.78	25.64	1.0
602	Total Phenols	3.17	0.27	0.29	3.73	5.37	1.4
703	Ammonia	1.56	0.08	0.17	1.81	1.50	0.8
705	TSS	10.33	0.86	0.76	11.95	11.02	0.9
706	TOC	9.19	0.87	0.62	10.68	8.58	0.8
707	COD	21.78	1.95	1.77	25.50	26.98	1.1
708	BOD	13.13	1.43	0.62	15.17	13.66	0.9
	Compounds whose influent value is greater than 2.0 times the calculated sum						
123	Dibromochloromethane	0.00	0.02	0.02	0.04	0.09	2.2
112	Trans-1,2-dichloroethylene	0.00	0.01	0.00	0.01	0.04	(4.0)
115	1,1,1-Trichloroethane	0.15	0.05	0.04	0.24	0.82	3.4
120	Trichloroethylene	0.08	0.00	0.22	0.30	2.52	8.4
127	Tetrachloroethylene	1.38	0.29	0.17	1.83	3.97	2.2
121	Benzene	0.04	0.02	0.01	0.08	0.62	7.8
128	Toluene	0.44	0.13	0.18	0.75	5.32	7.1
130	Ethylbenzene	0.04	0.02	0.01	0.07	1.38	20.0
315	Naphthalene	0.22	0.02	0.11	0.35	0.87	2.5
501	Antimony	0.88	0.00	0.05	0.92	4.66	5.1
505	Chromium	0.72	0.12	0.80	1.64	11.95	7.3
510	Nickel	0.72	0.07	0.08	0.87	4.05	4.6
601	Total Cyanides	0.02	0.01	0.30	0.33	1.29	3.9
	Compounds whose influent value is less than 0.5 times the calculated sum						
509	Mercury	0.12	0.00	0.00	0.12	0.04	(0.3)
511	Selenium	0.92	0.08	0.02	1.02	0.38	0.4
512	Silver	0.65	0.02	2.99	3.66	1.41	0.4
705	Oil and Grease	9.12	0.39	0.14	9.65	2.74	0.3

*classicals in 10^3 kg/day

Thirteen (13) of the priority pollutants are higher at the influent than projected by the sources. These tend to fall into two general organic groups--chlorinated solvents and aromatics--plus three metals and total cyanides. It is likely that each of these groups has a common origin. The industrial sampling sites in the Coldwater Creek basin included only about 8% of the total industrial flow and it is reasonable to assume that these chemicals may be due to unsampled industrial sources. The exception is dibromochloromethane; further analysis indicates that tap water is a significant additional source of this chemical. Four pollutants are estimated higher by the sources than the levels observed at the influent.

2. Sources of Pollutants

The relative contribution of pollutants from the different source types may be examined by calculating, from the scaled mass data presented above, the fraction contributed by each source type. For this analysis the individual scaled RES, COM and IND Kg/day values were divided by the SUM as shown in Table 27. The reader is cautioned that such an analysis assumes that the entire basin is as represented by the sources, an observation we know from the previous discussion to be not entirely true. It would perhaps be better to view the data in Table 27 as representative of a hypothetical drainage basin where composition was as represented in the Coldwater Creek sites, but scaled up based upon the relative flows for Coldwater Creek (these are RES = 78.3%, COM = 9.8%, IND = 11.9%).

Twenty-three (23) of the 30 priority pollutants and all 6 of the classical parameters attribute more than 50% of their mass contribution to the residential sources. Only trans-1,2-dichlorethylene is accounted for mostly by commercial sources. Six of the pollutants are predominantly due to the industrial sources. It should be emphasized that this analysis is limited by the small fraction of the industrial flow actually sampled. The mass balance analysis summarized in Table 26 would suggest that an additional 9 pollutants may have some industrial contributions since their influent values are substantially (>2 times) higher than their source sums. An analysis of this type will be more meaningful when the data from all the cities is combined.

Table 27

DOMINANT SOURCE OF POLLUTANTS FROM SITES SAMPLED AND SCALED TO ENTIRE BASIN

Compound	Fractional Distribution RES	COM	IND
Residential - greater than 50% of mass from residential sources			
113 Chloroform	0.58	0.12	0.31
115 1,1,1-Trichloroethane	0.63	0.20	0.18
121 Benzene	0.52	0.31	0.17
127 1,1,2,2-Tetrachloroethylene	0.75	0.16	0.09
128 Toluene	0.58	0.17	0.24
130 Ethyl Benzene	0.57	0.24	0.18
203 Phenol	0.91	0.05	0.04
301 Dichlorobenzenes	0.65	0.17	0.18
315 Naphthalene	0.63	0.06	0.31
326 Diethyl Phthalate	0.92	0.08	0.00
333 Di-n-butyl Phthalate	0.57	0.04	0.39
337 Butyl Benzyl Phthalate	0.83	0.09	0.07
338 Bis(2-ethylhexyl)phthalate	0.94	0.06	0.00
501 Antimony	0.95	0.00	0.05
504 Cadmium	0.66	0.00	0.34
506 Copper	0.81	0.07	0.12
507 Lead	0.89	0.05	0.06
508 Manganese	0.85	0.08	0.07
509 Mercury	0.96	0.04	0.00
510 Nickel	0.83	0.08	0.10
511 Selenium	0.90	0.08	0.02
514 Zinc	0.81	0.03	0.16
602 Total Phenols	0.85	0.07	0.08
703 Ammonia	0.86	0.04	0.09
704 Oil and Grease	0.94	0.04	0.01
705 TSS	0.86	0.07	0.06
706 TOC	0.86	0.08	0.06
707 COD	0.85	0.08	0.07
708 BOD	0.87	0.09	0.04
Commercial - greater than 50% of mass from commercial sources			
112 Trans-1,2-dichloroethylene	0.00	0.93	0.07
Industrial - greater than 50% of mass from industrial sources			
117 Bromodichloromethane	0.06	0.34	0.59
120 Trichloroethylene	0.26	0.00	0.74
123 Dibromochloromethane	0.08	0.35	0.57
505 Chromium	0.44	0.07	0.49
512 Silver	0.18	0.01	0.82
601 Total Cyanides	0.07	0.02	0.91

3. Tap Water Contribution

The potential contribution of tap water to the pollutant load at the POTW may be estimated from the measured tap water concentrations with the assumption that the tap water flow is equal to the influent flow. Such a flow estimate will be in error by the amount of inflow and infiltration in the system, data which were unavailable for this study. Table 28 shows the calculated mass flows for the tap water, compared with influent values. This analysis shows that the tap water could be a significant source of the trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane) and selenium. All other pollutants observed in the tap water constitute only a small fraction of the measured influent mass.

4. Treatment Plant Removal Efficiency

Both the influent and effluent were measured at the Coldwater Creek POTW, enabling an estimate of the removal efficiency to be made for those pollutants observed in the influent. Table 29 gives the mass rate for each pollutant and the estimated removal.

Most pollutants had high removal efficiency. The volatiles had 75-98% removal, presumably due to the aeration process, and the non-volatile organics were removed with 87-100% efficiency. Total cyanides and total phenols were also removed with good efficiency. The metals were quite variable in their removal, ranging from 0->75%. Manganese, nickel, selenium and silver showed less than 30% removal. The classical parameters showed high removal efficiencies, except for ammonia which showed a reduction of only 12%.

D. Review of Unusual Occurrences

A review of the chemical data reveals some unusually high concentration levels for certain chemicals, many of which occur in groupings which suggest a common cause. The chemicals are discussed below, along with the levels at which they were observed on the day under review and the range for the other days at that location.

Table 28

POTENTIAL TAP WATER CONTRIBUTION TO INFLUENT

Compound	Kg/day INF	Kg/day TAP[*]	TAP/INF
113 Chloroform	0.54	1.85	3.4
117 Bromodichloromethane	0.06	1.10	18.3
123 Dibromochloromethane	0.09	0.71	7.9
127 1,1,2,2-Tetrachloroethylene	3.97	0.13	0.03
128 Toluene	5.32	0.09	0.02
501 Antimony	4.66	1.06	0.23
506 Copper	4.11	0.57	0.14
507 Lead	18.56	2.52	0.14
511 Selenium	0.38	0.71	1.9
514 Zinc	25.64	1.28	0.05
703 Ammonia[**]	1.50	0.04	0.03
706 TOC[**]	8.58	0.71	0.08

[*] calculated assuming influent flow, 1022 Lps

[**] 10^3 Kg/day

Table 29

TREATMENT PLANT REMOVAL EFFICIENCY

	Kg/day		$\frac{\text{Inf - Eff}}{\text{Inf}} \times 100$
	Influent	Effluent	
112 Trans-1,2-dichloroethylene	0.04	0.00	100[a]
113 Chloroform	0.54	0.20	63
115 1,1,1-Trichloroethane	0.82	0.10	88
117 Bromodichloromethane	0.06	0.00	100[a]
120 Trichloroethylene	2.52	0.43	83
121 Benzene	0.62	0.32	48
123 Dibromochloromethane	0.09	0.03	66
127 1,1,2,2-Tetrachloroethylene	3.97	0.84	79
128 Toluene	5.32	0.13	98
130 Ethyl benzene	1.38	0.08	94
203 Phenol	0.93	0.00	100[a]
301 Dichlorobenzenes	2.30	0.00	100[a]
315 Naphthalene	0.87	0.00	100[a]
326 Diethyl phthalate	0.62	0.00	100[a]
333 Di-n-butyl phthalate	1.40	0.18	87
337 Butyl benzyl phthalate	1.00	0.00	100[a]
338 Bis(2-ethylhexyl) phthalate	0.38	0.00	100[a]
501 Antimony	4.66	1.98	58
504 Cadmium	0.26	0.08	69
505 Chromium	11.95	5.18	57
506 Copper	4.11	1.14	72
507 Lead	18.56	5.16	72
508 Manganese	17.79	12.40	30
509 Mercury	0.04	0.00	100[a]
510 Nickel	4.05	2.83	30
511 Selenium	0.38	0.51	0[b]
512 Silver	1.41	0.99	30
514 Zinc	25.64	8.22	68
601 Total Cyanides	1.29	0.00	100[a]
602 Total Phenols	5.37	0.74	86
703 Ammonia	1.50	1.32	12
704 Oil and Grease	2.74	0.07	97
705 TSS	11.02	1.58	86
706 TOC	8.58	2.26	74
707 COD	26.98	5.82	78
708 BOD	13.66	1.57	88

[a] Removal efficiency may actually be <100% due to the possibility of some pollutants being present below the reporting limits.

[b] Addition of metal observed.

Brightwell - Thursday

Chemical	Concentration	Range for Other Days
128 Toluene	38	1-12
130 Ethylbenzene	15	0-4
315 Naphthalene	94	0-14
331 Anthracene/ Phenanthracene	107	0
335 Pyrene	9	0
504 Cadmium	31	0-4
601 Total Cyanides	11	0

The aromatics all occurred simultaneously and showed a greater concentration in the higher molecular weight species suggesting a fuel oil type source. The co-occurrence of cadmium and total cyanides suggest a plating type operation of some sort. However, there were no activities of this type listed in the source inventory.

Frost - Saturday

Chemical	Concentration	Range for Other Days
201 2-Chlorophenol	15	0
203 Phenol	0	0-17
205 2,4-dichlorophenol	15	0
206 2,4,6-trichlorophenol	12	0

This analytical sample was the only acids fraction which had a large amount of oxidant present as indicated by a strong odor, both upon collection and after return to the lab, and a positive KI starch paper test. It appears that there was either excess chlorine or hypochlorite in the sample which reacted in the phenol which was frequently present to form the chlorophenols. It seems likely that these changes occurred during sample storage prior to the extraction. The sample was also quite basic, pH 9-12 during the day.

VII. CONCLUSIONS

Completion of this study of the second in a series of cities has demonstrated that the lessons learned from the first (pilot study) city (Cincinnati) were useful in modifying procedures for planning the St. Louis survey and that certain aspects of the program are still problematic. The priority pollutant data collected in this study are consistent with that obtained previously and indicate that the overall program goals can be met, once a sufficient number of drainage basins have been studied.

A total of 47 pollutants, 32 organic priority pollutants, 12 priority pollutant metals plus manganese, total cyanides and total phenols were observed in St. Louis; six classical parameters were also measured. A number of the 47 were observed only 1 or 2 times. Only 1 pesticide, Aldrin, was observed - twice. Seventy-nine (79) of the pollutants were never observed. Many of the pollutants were detected at low concentration levels; only 5 organics, 8 metals, total cyanides, and total phenols were present at overall average concentrations greater than 10 µg/L. Three organic pollutants and six metals were observed in 90-100% of the samples.

Sources - residential, commercial, industrial - showed the presence of 46 pollutants: 31 organics, 13 metals, total cyanides, and total phenols. Source pollutants present at least 50% of the time included 10 organics, 7 metals and total phenols; 14 organics and 2 metals were present in the sources less than 10% of the time. The concentration data do not show many chemical intensity level differences between the source categories. The mass flow data indicate that more than 50% of the mass of 23 out of 30 priority pollutants and the six classical parameters is contributed by the residential sources.

An analysis of water flow within the sites and the basin shows a good closure (within 5%) when the measured flows are compared to those estimated from water use records and a per capita discharge flow. The water use records, therefore, appear to be a reliable index of flow discharge from commercial and industrial sources.

At the Coldwater Creek Water Treatment Plant samples of the effluent as well as the influent were obtained, enabling an evaluation of the removal efficiencies to be made. The average removal efficiency for the organics was 89%; some of the trihalomethanes displayed removal efficiencies around 65% and benzene was removed at only 48%. Most of the metals were removed with efficiencies around 70%. However, manganese, nickel, and zinc had 30% removals and selenium exhibited an increase in mass load across the treatment plant. With the exception of ammonia (12%), the removal efficiencies for total cyanides, total phenols, and the classicals were all quite high.

The QC/QA results for the Coldwater Creek survey are very good. For the organics, most recovery values are in the 80% to 90% range and precision is generally within 10% to 30% - an improvement over the Cincinnati survey. Chemical analysis procedures have also been modified for some pollutants. The quality control data improved considerably for the metals, as a result of implementing the recommendations for use of higher spiking levels for certain metals and use of the DC plasma technique. The quality control program continues to be invaluable in terms of daily checks on the chemical analyses and in terms of establishing the reliability of the data for subsequent calculations and projections.

The internal standard, d_{10}-anthracene, was added to the aqueous sample prior to extraction and concentration for the acid and base/neutral analyses. The d_{10}-anthracene acted as a monitor of the total system, a departure from the procedure most often recommended by EPA. The data were analyzed to determine whether the recovery data and, therefore, the individual pollutant concentrations were affected. It was shown that the d_{10}-anthracene had been extracted with 95-100% efficiency, making use of a correction factor unnecessary.

The selection and isolation of sampling areas containing only one type of source activity, i.e., residential, commercial, or industrial, continues to be problematic. The collection system bears little resemblance to the surface zoning, and the system maps frequently are not complete relative to direction of flow and location of manholes. A great deal of site preparation must be put in to accurately locating areas whose land use is satisfactory.

VIII. REFERENCES

1. "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants," U.S. EPA, EMSL, Cincinnati, Ohio, March, 1977, revised April, 1977.

2. "Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants " I. Literature Review, EPA, MDSD, Final Report on Task Order No. 6, Contract No. 68-01-3857, Report No. ADL 81099-50, June, 1979.

3. "Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants " II. Muddy Creek Drainage Basin, Cincinnati, Ohio, EPA, MDSD, Final Report on Task Order No. 6, Contract No. 68-01-3857, Report No. ADL 81099-51, June, 1979.

4. Housing Conservation Guide for the St. Louis Region Census Tract Analysis, by East-West Gateway Coordinating Council, January, 1978.

5. June 5, 1978, Recommendations for GC Columns to Improve GC Performance in Extractable Priority Pollutant Analysis, Memo from W.M. Shackelford, Analytical Chemistry Branch, Athens, GA 30605.

APPENDIX A

DETAILS OF THE SAMPLING PLAN

On November 26, 1978, fourteen employees of Arthur D. Little went to St. Louis to obtain wastewater samples from sewers within the Coldwater Creek sewage district. These employees were under the immediate supervision of Jeffrey Adams and Kenneth Menzies.

Actual sampling activities began on Tuesday, November 28, at approximately 8:00 a.m., and continued until Monday, December 4, at 8:00 a.m. Throughout this period of time, six teams of Arthur D. Little employees were on duty at all hours of the day and night. Four of these teams were actively engaged in sample collection at each of the eight sampling sites that we identified, while two teams provided logistical backup and, to a limited extent, participated in the collection of samples, i.e., at the POTW.

At any given time, three teams were on duty; one stationed at the Coldwater Creek plant, with the remaining two teams rotating between field sites. After 12 hours, each of the three teams were replaced by a fresh team as work continued.

The two rotating field teams were responsible for collecting samples at four-hour intervals from each of the following locations:

Town/City	Site	Description
Blackjack	Eppingham	New Residential
Blackjack	Avocado	New Residential & Commercial
	Cross Keys	Commercial & Apartments
Florissant	Brightwell	Old Residential
Berkeley	Wabash	Mixed
	Frost	Industrial & Old Residential
Hazelwood	Brown	Industrial
St. Ann	Northwest	Commercial & Old Residential

In addition, the logistics teams collected samples of the POTW influent, effluent and a tap water sample.

To accomplish this, the two field teams were driven through the drainage area in rented (Ryder) 12-foot trucks containing all the supplies necessary to accomplish the job. As each team finished its shift, the truck returned to the POTW for supplies and sample drop-off. From this point, the logistics crew was responsible for the logging in and packaging of all collected samples prior to their shipment to our laboratory.

A summary of the 24-hour composite samples collected in St. Louis is given in Table A-1. Sampling schedules, as well as the minimum number and size of collection bottles required by each team, have been summarized below in Tables A-2 through A-4. In addition, the sampling plans utilized for QC samples, regular samples, and blanks have been outlined in Table A-5 through A-7.

All samples were taken by the Manual Sampling Collection method in Table A-8 and preserved according to the requirements in Table A-9. The 24-hour average flow observed at each of the sampling sites is given in Table A-10. These flow values were obtained by adjusting the flows originally calculated using the Manning equation by a correction factor based on a measured velocity calibration, as discussed in Section IV.

Table A-1

SUMMARY OF 24-HOUR COMPOSITES COLLECTED

Site and Description	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Composition of Samples
Tap Water		X				X	6 Increments
POTW Influent	X	X	X	X	X	X	6 Increments
POTW Effluent	X	X	X	X	X	X	6 Increments
EPPINGHAM New Residential	X	X	X	X	X	X	6 Increments
AVOCADO New Residential	X	X	X	X	X	X	6 Increments
CROSS KEYS Commercial	X	X	X	X	X	X	6 Increments
BRIGHTWELL Old Residential	X	X	X	X	X	X	6 Increments
Field Blank			X				6 Increments
WABASH Mixed	X	X	X	X	X	X	6 Increments
FROST Industrial	X	X	X	X	X	X	6 Increments
BROWN Industrial	X	X	X	X	X	X	6 Increments
NORTHWEST Commercial	X	X	X	X	X	X	6 Increments
Field Blank				X			6 Increments

Table A-2

SAMPLING SCHEDULE IN ST. LOUIS

	TEAM I	IN: 0730	OUT: 2030	TEAM III	IN: 1930	OUT: 0830
			TUESDAY and WEDNESDAY			
Eppingham	0800	1200	1600	2000	0000	0400
Avocado	0900	1300	1700	2100	0100	0500
Cross Keys	1000	1400	1800	2200	0200	0600
Brightwell	1100	1500	1900	2300	0300	0700
			THURSDAY			
Eppingham	0800	1200	1600	2000	0000	0400
Avocado	0900	1300	1700	2100	0100	0500
Cross Keys	1000	1400	1800	2200	0200	0600
Brightwell	1100	1500	1900	2300	0300	0700
Field Blank	0930	1330	1730	2130	0130	0530
			FRIDAY, SATURDAY, SUNDAY			
Eppingham	0800	1200	1600	2000	0000	0400
Avocado	0900	1300	1700	2100	0100	0500
Cross Keys	1000	1400	1800	2200	0200	0600
Brightwell	1100	1500	1900	2300	0300	0700

Table A-2 (Cont'd)

SAMPLING SCHEDULE IN ST. LOUIS

	TEAM II	IN: 0715	OUT: 2015	TEAM IV	IN: 1915	OUT: 0815
			TUESDAY, WEDNESDAY, THURSDAY			
Wabash	0800	1200	1600	2000	0000	0400
Frost	0900	1300	1700	2100	0100	0500
Brown	1000	1400	1800	2200	0200	0600
Northwest	1100	1400	1900	2300	0300	0700
			FRIDAY			
Wabash	0800	1200	1600	2000	0000	0400
Frost	0900	1300	1700	2100	0100	0500
Brown	1000	1400	1800	2200	0200	0600
Northwest	1100	1500	1900	2300	0300	0700
Field Blank	0930	1330	1730	2130	0130	0530
			SATURDAY, SUNDAY			
Wabash	0800	1200	1600	2000	0000	0400
Frost	0900	1300	1700	2100	0100	0500
Brown	1000	1400	1800	2200	0200	0600
Northwest	1100	1500	1900	2300	0300	0700

Table A-3

MINIMUM NUMBER AND SIZE OF BOTTLES REQUIRED BY TEAMS 1 + 3 AT EACH SITE, DURING EACH VISIT

SAMPLING SITE	DAY					
	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
AVOCADO New Residential and Commercial	12 x 1L[a] 1 x 45 mL (QC)	5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL	5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL	5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL	12 x 1L[a] 1 x 45 mL (QC)	5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL
EFFINGHAM New Residential	5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL	——— SAME AS TUESDAY & SUNDAY ———				5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL
BRIGHTWELL Old Residential	5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL	12 x 1L[a] 1 x 45 mL (QC)	5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL	12 x 1L[a] 1 x 45 mL (QC)	5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL	5 x 1L[a] 1 x 500 mL 2 x 250 mL 1 x 45 mL
CROSS KEYS Commercial and New Residential	5 x 1L[a] 1 x 500 mL 2 x 250 mL	——— SAME AS TUESDAY & SUNDAY ———				5 x 1L[a] 1 x 500 mL 2 x 250 mL
FIELD BLANK	Not Collected	Not Collected	3 x 1L[a] 1 x 500 mL 3 x 250 mL 5 x 45 mL[b]	Not Collected	Not Collected	Not Collected

[a] This includes the 1L bottle for Oil and Grease fraction that only has to be collected twice each day (one by each team).

[b] All 5 x 45 mL bottles are collected by Team 1 during their first field blank increment.

Table A-3 (Cont'd)

MINIMUM NUMBER AND SIZE OF BOTTLES REQUIRED BY TEAMS 2 + 4 AT EACH SITE, DURING EACH VISIT

SAMPLING SITE	DAY					
	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
WABASH Old Residential and Industrial	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	— S A M E A S T U E S D A Y & S A T U R D A Y —			5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	12 x 1L[a] 1 x 45 ml. (QC)
FRONT Industrial and Old Residential	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	12 x 1L[a] 1 x 45 ml. (QC)	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.
ARROW Industrial	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 25 ml.	12 x 1L[a] 1 x 45 ml. (QC)	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.
NORTHWEST Commercial and Old Residential	12 x 1L[a] 1 x 45 ml. (QC)	5 x 1L[a] 1 x 500 ml. 2 x 250 ml. 1 x 45 ml.	— S A M E A S W E D N E S D A Y & S U N D A Y —			5 x 1L[a] 1 x 500 ml.
FIELD BLANK	Not Collected	Not Collected	Not Collected	3 x 1L[a] 1 x 500 ml. 3 x 250 ml. 5 x 45 ml.[b]	Not Collected	Not Collected

[a] This includes the 1L bottle for Oil and Grease fraction that only has to be collected twice each day (one by each team).

[b] All 5 x 45 ml. bottles are collected by Team 2 during their first field blank increment.

Table A-4

MINIMUM NUMBER AND SIZE OF BOTTLES REQUIRED BY LOGISTICS TEAMS AT EACH SITE DURING EACH VISIT

POTW Influent -- Tuesday, Wednesday, Saturday, Sunday

Times --	0900	5 x 1L[a]
	1300	1 x 500 mL
	1700	2 x 250 mL
	2100	1 x 45 mL
	0100	
	0500	

Tap Water -- Wednesday and Sunday

Times --	0930	3 x 1L[a]
	1330	1 x 500 mL
	1730	3 x 250 mL
	2130	1 x 45 mL
	0130	
	0530	

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[a] This includes 1L bottle collected for oil and grease fraction; should only be collected once by each team on each day.

Table A-5

Plan A-1 — Each time a QC sample is withdrawn from a manhole at one of the following sites, the following number and size of bottles are to be filled:

Avocado	2 days
Brightwell	2 days
Frost	1 day
Northwest	1 day
Wabash	1 day
Brown	1 day

			Code
For Acid/Base Neutral PCB/Pesticide fraction	Collect	4 x 1L	ABN,PCB
For Volatile fraction[a]	Collect at least 1 x 45 mL screw cap vial--do not leave any bubbles in vials		VOA

Note: These three fractions are air-freighted to Boston daily

- -

For TOC, COD and NH_3 fraction[a]	Collect	1 x 1L	NH_3
For Metal and Mercury fraction[a]	Collect	2 x 1L	M,Hg
For Total Phenol fraction[a]	Collect	1 x 1L	Phen
For Cyanide fraction[a]	Collect	1 x 1L	CN
For Total Suspended Solid and BOD fraction	Collect	1 x 1L	Class BOD,TSS
For Asbestos fraction	Collect	1 x 1L	As
For Oil and Grease fraction[a]	Collect	1 x 1L	Class, O+G

Note: The oil and grease fraction is only to be collected twice each day, at each site. I would strongly suggest that this be done during each team's first rotation between sites.

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[a] See Table A-9 for sample preservation.

Table A-6

Plan A-2 — Each time a regular sample is withdrawn from a manhole at one of the following sites, the following number and size of bottles are to be filled:

Eppingham
Avocado
Brightwell
Cross Keys
Brown
Frost
Wabash
Northwest
POTW-Influent and Effluent

This does not apply to QC samples.

			Code
For Acid/Base Neutral fraction	Collect	1 x 1L	ABN
For PCB/Pesticide and Asbestos fraction	Collect	1 x 1L	PCB,As
For Volatile fraction[a]	Collect at least 1 x 45 mL screw cap vial—do not leave any bubbles in the container		VOA

Note: These four fractions are air-freighted to Boston daily

For TOC, COD and NH_3 fraction[a]	Collect	1 x 1L	NH_3
For Metal and Mercury fraction[a]	Collect	1 x 500 mL or equivalant	M^+,Hg
For Total Phenol fraction[a]	Collect	1 x 250 mL or equivalent	Phen
For Cyanide fraction[a]	Collect	1 x 250 mL or equivalent	CN
For Total Suspended Solid and BOD fraction	Collect	1 x 1L	Class BOD,TSS
For Oil and Grease fraction[a]	Collect	1 x 1L	Class, O+G

Note: The oil and grease fraction is only to be collected twice each day at each site. I would strongly suggest that this be done during each team's first rotation between sites.

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[a] See Table A-9 for sample preservation.

Table A-7

Plan A-3 -- Each time a Field Blank or a Tap Water sample is obtained, the following number and size of bottles are to be collected:

			Code
For Acid/Base Neutral and PCB/Pesticide fraction	Collect	1 x 1L	ABN,PCB
For Volatile fraction[a] Note: These three fractions are air-freighted to Boston daily	Collect at least 1 x 45 mL screw cap vial for each increment of tap water Collect 5 x 45 mL screw cap vials during first increment of field blank sample		VOA

- -

For TOC, COD, and NH_3 fraction[a]	Collect	1 x 500 mL or equivalent	NH_3
For Metal and Mercury fraction[a]	Collect	1 x 250 mL or equivalent	M^+,Hg
For Total Phenol fraction[a]	Collect	1 x 250 mL or equivalent	Phen
For Cyanide fraction[a]	Collect	1 x 250 mL or equivalent	CN
For Asbestos, Total Suspended Solids and BOD fraction	Collect	1 x 1L	As, Class BOD,TSS
For Oil and Grease fraction[a]	Collect	1 x 1L	Class, O+G

Note: The oil and grease fraction is only to be collected twice each day, at each site. I would strongly suggest that this be done during each team's first rotation between sites.

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[a] See Table A-9 for sample preservation.

Table A-8

What to do During Manual Sample Collection

1) Gain access to the sampling location.

2) Set up page in field log notebook as per example. Use one page per sample location and visit. Example: since Kirkridge Acres is visited 4 times per work shift, 4 separate notebook pages should be used. In addition, 1 or 2 pages should be reserved for comments about each site per shift.

3) Fill in all preliminary data in field notebook: location, collectors (initials are sufficient), time, and date.

4) Using the telescoping pole and bucket, obtain a wastewater sample.

5) While keeping the contents of the bucket well mixed, measure and record the pH and temperature of the wastewater. Also test sample with potassium iodide test paper. (If test is positive [paper turns blue] collect and preserve 2 additional VOA bottles. (see Table B3)

6) Attach the sample labels to the appropriate number and size of bottles. Number and size information is given in plans A1 through A7.

7) Fill in all the information required on labels.

8) After labeling requirements are completed, seal the label with 2" wide scotch tape.

9) Fill all 1L bottles to the neck with sample. Preserve appropriate bottles as below. Fill VOA bottles to overflowing (except if preservative is added as per Attachment C).

10) Add preservative to each bottle that requires it (see Table B3) i.e.,

Phenols	H_2SO_4 plus 1 gm/L $CuSO_4 \cdot 5H_2O$
Cyanides	Ascorbic acid until KI paper shows no color, plus 0.6 gm excess per liter plus 2 mL/L 10N sodium hydroxide.
Metals	5 mL/L concentrated nitric acid
Mercury	5 mL/L concentrated nitric acid
Total organic carbon COD NH_3	Concentrated sulfuric acid
Oil and Grease	Concentrated sulfuric acid

Volatiles as required.

11) Cover all bottle mouths (except VOAs) with Teflon film and seal with screw caps.

Table A-8 (continued)

12) Cover all VOAs bottles with Teflon silicon septum (Teflon side towards sample). These bottles should not have any air bubbles in them!!!

13) Transcribe sample bottle number from label onto cap of bottle with yellow marker.

14) Transcribe sample bottle number and fraction identification code into field notebook.

15) Pack all bottles into ice chests. Segregate all Acid/Base Neutral, PCB/Pesticide and VOA fractions into one chest, i.e., all these fractions from all sites are stored in one chest. All other samples are stored in other chests as required.

16) Measure and record depth (cm) using dip rule and grease.

17) Close up manhole and move to next site.

Table A-9

Sample Preservation Requirements

Total Phenols:	Check pH of raw sample. Add 1 mL conc H_2SO_4, mix well and then recheck pH with test paper. If pH <4, stop. If pH >4, add 1 mL H_2SO_4 and recheck pH. Record amount of H_2SO_4 added. Add 1 gm/L $CuSO_4 \cdot 5H_2O$.
Cyanides:	Test each bottle collected with potassium iodide starch test paper. If color is blue, add one small scoop ($\sim$ 0.6 grams) ascorbic acid and shake well. Recheck with test paper until test paper shows no color. Add 0.6 gm excess of ascorbic acid (one scoop) to each liter bottle collected. Then add 2 mLs of 10 N sodium hydroxide and mix well.
Metals:	Add 5 mLs of concentrated nitric acid (HNO_3) to each liter bottle collected for metals. Check final pH with pH test paper. If pH <2, stop. If pH >2, add 1 mL increments until pH <2. Record total amount of HNO_3 added.
Mercury:	Add 5 mLs of concentrated nitric acid (HNO_3) to each liter bottle collected for mercury. Check final pH with pH test paper. If pH <2, stop. If pH >2, add 1 mL increments until <2. Record total amount of HNO_3 added.
Volatiles:	Check sample collected with potassium iodide starch indicator paper. If test shows positive (paper turns blue) add two drops of sodium thiosulfate solution to each of two bottle samples. Seal each bottle so no air bubble shows when bottle inverted. In addition, collect two bottles that are not preserved. Record on label which bottle preserved and which bottle not preserved.
Total Organic Carbon Ammonia:	Check pH of sample with pH test paper. Add 1 mL H_2SO_4 and check pH. If <2, stop. If >2, add 1 additional mL H_2SO_4, mix, and check pH. pH must be <2. Record volume of H_2SO_4 added.
Oil and Grease:	Check pH of sample with pH test paper. Add 1 mL H_2SO_4 and check pH. If <2, stop. If >2, add 1 additional mL H_2SO_4, mix, and check pH. pH must be <2. Record volume of H_2SO_4 added.

Table A-10

AVERAGE CORRECTED FLOW VALUES

Location	Average Daily Flow (LPS)						Average
	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	
POTW INFLUENT	1069	1021	1034	1003	986	1016	1022
POTW EFFLUENT	1060	1060	973	946	955	942	989
EPPINGHAM (0.687)[a]	14.6	15.2	17.0	16.6	17.8	14.0	15.9
AVOCADO (0.792)	19.6	20.4	47.3	38.1	28.9	37.0	31.9
BRIGHTWELL (0.659)	7.4	7.8	8.4	6.3	9.0	8.0	7.8
WABASH (1.560)	84.4	87.7	87.7	82.2	103.1	91.7	89.5
CROSS KEYS (0.660)	16.0	14.7	15.3	15.0	14.4	16.1	15.2
NORTHWEST (0.353)	34.1	36.6	35.0	36.3	38.2	42.7	37.2
FROST (0.676 and 0.292)	119.6[b]	119.6[b]	125.8	110.4	121.0	121.0	119.6
BROWN (0.501)	6.1[b]	6.1[b]	6.1[b]	9.5	4.9	4.0	6.1
$\sum$ All Independent Sources							218

Values in parentheses are the correction factors used to adjust flows on the basis of velocity measurements.

[a] Average of eight measured correction factors = 0.687. This value was applied to Eppingham data where no measured correction factor was obtained.

[b] Average flow values substituted for unobtainable flow measurements.

APPENDIX B

DETAILS ON ANALYTICAL METHODS

The analytical methods for each priority pollutant category have been described in the Cincinnati report[3]. The basic procedures used in this program were as described in the "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants", U.S. EPA, Cincinnati, Ohio[1]. Where the methods differed from those used for Cincinnati samples, detailed descriptions have been included. The categories for which the methods were the same as those used for the Cincinnati samples are:

Volatiles
Acids
Total Cyanides
Total Phenols

The categories for which the methods differed from those used for the Cincinnati samples are:

Base/Neutrals
Pesticides and PCBs
Metals

The section for each category includes a brief description of methods noting differences from Cincinnati and any problems encountered. Also included, where appropriate, are tables by category containing analytical information, relative retention times, reporting limits, calibration data, and the quality control data for the priority pollutants. Explanation of symbols and data calculations are summarized in Table B-1.

Volatiles Method

Table B-2 lists the volatile compounds analyzed, their relative retention times and the calibration values used for concentration calculations. The calibration data obtained during the St. Louis study were very similar to the Cincinnati data for all the volatile priority pollutants.

Table B-3 presents the quality control data from the St. Louis study. Table B-4 presents the comparison of quality control data from Cincinnati and St. Louis. Overall, the quality control data determined for St. Louis were comparable to the Cincinnati quality control data. The precision was somewhat improved for St. Louis.

As in the Cincinnati study, the quality control data for methylene chloride were erratic. This is probably due to a sporadic contamination problem.

It is likely that the volatile compounds that were not detected, i.e., chloromethane, dichlorodifluoromethane, bromomethane, vinyl chloride and chloroethane, broke through the Tenax/Silica Gel trap. These compounds were also not detected in the Cincinnati study. The EPA method[1] does not work for these compounds at the 1 μg/L level.

Acids Method

For the analytes included in the acid method, the relative retention times and the calibration values used for concentration calculations are listed in Table B-5. For all the acid priority pollutants except 2-chlorophenol and 2,4-dimethylphenol, the St. Louis calibration data were very similar to the Cincinnati data. The calibration curves were changed for these two phenols.

Table B-6 presents the quality control data from the St. Louis study. Table B-7 presents the comparison of quality control data from Cincinnati and St. Louis. The overall quality control data from Cincinnati and St. Louis were comparable.

The data was not as good during the St. Louis study for 2,4-dinitrophenol and 4,6-dinitro-2-cresol. The chromatography on the 1% SP 1240 DA GC column for these two compounds was poor. The chromatography for the two

Table B-1

EXPLANATION OF SYMBOLS & CALCULATION OF DATA

Symbols used on the data sheets are defined below:

A = Raw wastewater, spiked

B = Raw wastewater, spiked as replicate of A

C = Unknown = raw wastewater, unspiked

D = Method reference standards,
= MilliQ water, spiked at same level as A and B

F = Method blank
= MilliQ water, unspiked

O_i = Observed value, μg/L

T_i = True (theoretical) value, μg/L

X_i = Observed value, μg/L - unknown value, μg/L

P_i,% = $\frac{100\ (O_i)}{T_i}$ = % Recovery

$\bar{X}_i$ = Mean of replicate spikes A and B
= $\frac{X_i\ (A) + X_i\ (B)}{2}$

R_i = Range of replicate spikes A and B
= $|X_i\ (A) - X_i\ (B)|$

n = Number of data points

C = Spike concentration, μg/L

R_c = Critical range for a specific concentration

$$= \frac{3.27\ (C) \sum_{i=1}^{n} R_i}{\sum_{i=1}^{n} \bar{X}_i}$$

$\bar{P}$ = Mean % Recovery

$$= \frac{\sum_{i=1}^{n} P_i}{n}$$

S_p = Standard deviation of percentages

$$= \sqrt{\frac{\sum_{i=1}^{n} (P_i - \bar{P})^2}{n - 1}}$$

$\%S_p$ = Relative standard deviation of percentages

$$= \frac{100\ (S_p)}{\bar{P}}$$

Table B-2

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

Volatiles

COMPOUND	RRT [a]	Slope [b]	Intercept	Reporting Limit µg/l	Reporting Limit Area
101. Chloromethane	–	–	–	–	–
102. Dichlorodifluoromethane	–	–	–	–	–
103. Bromomethane	–	–	–	–	–
104. Vinyl chloride	–	–	–	–	–
105. Chloroethane	.311	66.944	-4.554	1	.0800
106. Methylene chloride	.396	35.576	-14.818	1	.4500
107. Acrolein	.411	1739.700	5.798	7	.0010
108. Trichlorofluoromethane	.394	59.584	5.412	6	.0100
109. Acrylonitrile	.445	55.067	-6.808	1	.1500
110. 1,1–Dichloroethylene	.470	63.118	4.361	5	.0100
111. 1,1–Dichloroethane	.524	18.397	1.793	2	.0110
112. Trans–1,2–dichloroethylene	.558	59.189	-.233	1	.0300
113. Chloroform	.583	17.349	.775	1	.0200
114. 1,2–Dichloroethane	.621	448.342	-.218	1	.0030
115. 1,1,1–Trichloroethane	.690	29.649	.093	1	.0300
116. Carbon tetrachloride	.710	35.231	-.763	1	.0500
117. Bromodichloromethane	.757	293.371	-.475	1	.0050
118. 1,2–Dichloropropane	.823	1034.500	-2.749	1	.0040
119. Trans–1,3–dichloropropylene	.848	23.050	.428	1	.0300
120. Trichloroethylene	.875	53.552	-9.03	1	.0400
121. Benzene	.878	11.482	.630	1	.0400
122. Cis–1,3–dichloropropylene	.930	31.592	-.668	1	.0600
123. Dibromochloromethane	.933	36.445	.075	1	.0300
124. 1,1,2–Trichloroethane	.933	42.268	-.636	1	.0400
125. Bromoform	1.106	34.510	2.331	3	.0200
126. 1,1,2,2–Tetrachloroethane	1.259	17.904	-.241	1	.0700
127. 1,1,2,2–Tetrachloroethylene	1.245	67.633	.656	1	.0050
128. Toluene	1.297	20.991	-1.201	1	.1100
129. Chlorobenzene	1.404	18.302	.167	1	.0500
130. Ethyl benzene	1.585	41.696	-1.880	1	.0700

a. Relative to 2-bromo-1-chloropropane, retention time 14.50 minutes.

b. X = response , Y = concentration

Table B-3

QUALITY CONTROL DATA

Volatiles

COMPOUND	METHOD REFERENCE[a]			RAW WASTEWATER[b]				
	$\overline{P}$	Sp	% Sp	c	R_c	$\overline{P}$	Sp	% Sp
101. Chloromethane	–	–	–	–	–	–	–	–
102. Dichlorodifluoromethane	–	–	–	–	–	–	–	–
103. Bromomethane	–	–	–	–	–	–	–	–
104. Vinyl chloride	–	–	–	–	–	–	–	–
105. Chloroethane	–	–	–	–	–	–	–	–
106. Methylene chloride	103	183	177	20	65	302	820	271
107. Acrolein	143	79	55	100	164	57	85	149
108. Trichlorofluoromethane	18	17	94	20	28	25	17	68
109. Acrylonitrile	55	9	16	100	19	57	11	20
110. 1,1–Dichloroethylene	11	28	265	20	23	24	32	134
111. 1,1–Dichloroethane	68	4	6	20	9	69	14	20
112. Trans–1,2–dichloroethylene	46	33	71	20	12	48	35	73
113. Chloroform	66	7	10	20	12	60	15	24
114. 1,2–Dichloroethane	100	5	5	20	3	105	18	17
115. 1,1,1–Trichloroethane	78	14	19	20	12	78	19	24
116. Carbon tetrachloride	66	21	32	20	9	64	17	27
117. Bromodichloromethane	74	9	12	20	4	80	11	14
118. 1,2–Dichloropropane	120	11	9	20	4	121	17	14
119. Trans–1,3–dichloropropylene	74	6	9	20	2	74	5	7
120. Trichloroethylene	99	16	16	20	8	103	23	23
121. Benzene	90	4	4	20	2	83	4	5
122. Cis–1,3–dichloropropylene	80	5	6	20	2	80	2	3
123. Dibromochloromethane	75	8	11	20	2	81	8	9
124. 1,1,2–Trichloroethane	96	4	4	20	1	96	4	4
125. Bromoform	69	19	27	20	2	72	18	25
126. 1,1,2,2–Tetrachloroethane	66	14	21	20	3	66	11	17
127. 1,1,2,2–Tetrachloroethylene	116	37	31	20	4	104	31	30
128. Toluene	144	26	18	20	5	131	11	9
129. Chlorobenzene	118	10	9	20	2	117	12	10
130. Ethyl benzene	139	9	2	20	3	148	24	16

a. Calculated from 7 data points. b. Calculated from 14 data points.

Table B-4

COMPARISON OF QUALITY ASSURANCE DATA

Volatiles

SPECIES	CINCINNATI				ST. LOUIS			
	Method Ref. Std. [a]		Raw Wastewater Spike [b]		Method Ref. Std. [c]		Raw Wastewater Spike [d]	
	$\bar{P}$	Sp	$\bar{P}$	Sp	$\bar{P}$	Sp	$\bar{P}$	Sp
101. Chloromethane	-	-	-	-	-	-	-	-
102. Dichlorodifluoromethane	-	-	-	-	-	-	-	-
103. Bromomethane	-	-	-	-	-	-	-	-
104. Vinyl chloride	-	-	-	-	-	-	-	-
105. Chloroethane	38	25	22	38	-	-	-	-
106. Methylene chloride	69	61	51	132	103	183	302	820
107. Acrolein	68	32	24	29	143	79	57	85
108. Trichlorofluoromethane	39	24	42	35	18	17	25	17
109. Acrylonitrile	91	27	98	24	55	9	57	11
110. 1,1-Dichloroethylene	60	32	59	39	11	28	24	32
111. 1,1-Dichloroethane	70	8	67	29	68	4	69	14
112. Trans-1,2-dichloroethylene	90	35	82	50	46	33	48	35
113. Chloroform	85	26	72	27	66	7	60	15
114. 1,2-Dichloroethane	108	14	93	33	100	5	105	18
115. 1,1,1-Trichloroethane	89	29	83	31	78	14	78	19
116. Carbon tetrachloride	93	36	78	34	66	21	64	17
117. Bromodichloromethane	98	9	90	22	74	9	80	11
118. 1,2-Dichloropropane	100	34	99	37	120	11	121	17
119. Trans-1,3-dichloropropylene	89	10	82	9	74	6	74	5
120. Trichloroethylene	118	16	119	19	99	16	103	23
131. Benzene	88	7	90	11	90	4	83	4
122. Cis-1,3-dichloropropylene	91	13	84	17	80	5	80	2
123. Dibromochloromethane	94	11	85	15	75	8	81	8
124. 1,1,2-Trichloroethane	109	10	101	13	96	4	96	4
125. Bromoform	82	11	70	11	69	19	72	18
126. 1,1,2,2-Tetrachloroethane	77	42	59	44	66	14	66	11
127. 1,1,2,2-Tetrachloroethylene	102	14	101	23	116	37	104	31
128. Toluene	99	31	96	31	144	26	131	11
129. Chlorobenzene	98	31	111	32	118	10	117	12
130. Ethyl benzene	122	21	122	32	139	9	148	24

a. Calculated from 15 data points

b. Calculated from 30 data points

c. Calculated from 7 data points

d. Calculated from 14 data points

Table B-5

VALUES FOR CONCENTRATION CALCULATION

Acids

Sample Number and Compound	RRTs [a]	Slope [b]	Intercept	Reporting Limit area	Reporting Limit ng
201. 2–Chlorophenol	.33	13.6852	7.4389	.1871	10
202. 2–Nitrophenol	.38	30.2558	5.8283	.1380	10
203. Phenol	.47	14.0816	2.2864	.5480	10
204. 2,4–Dimethylphenol	.56	18.0665	6.4790	.1949	10
205. 2,4–Dichlorophenol	.58	17.9196	4.9780	.2800	10
206. 2,4,6–Trichlorophenol	.72	23.5207	5.6063	.1870	10
207. 4–Chloro–3–cresol	.83	19.9290	.7696	.4630	10
208. 2,4–Dinitrophenol	1.05	73.4759	19.4594	.0750	25
209. 4,6–Dinitro–2–cresol	1.05	46.9461	13.7729	.2390	25
210. Pentachlorophenol	1.19	51.9267	3.7533	.4090	25
211. 4–Nitrophenol	1.99	41.8218	11.6772	.3190	25

a. Retention times relative to D_{10}-anthracene, 12.83 min.

b. X = response, Y = concentration

Table B-6

QUALITY CONTROL DATA

Acids

Compound	Method Reference[a]			Raw Wastewater[b]				
	$\overline{P}$	Sp	% Sp	C	R_c	$\overline{P}$	Sp	% Sp
201. 2-Chlorophenol	92	12	12	50	14	106	17	16
202. 2-Nitrophenol	105	17	17	50	22	114	23	20
203. Phenol	71	11	15	50	27	72	15	22
204. 2,4-Dimethylphenol	77	12	16	50	16	99	20	20
205. 2,4-Dichlorophenol	104	11	10	50	14	123	21	17
206. 2,4,6-Trichlorophenol	95	11	11	50	16	111	17	15
207. 4-Chloro-3-cresol	95	11	11	50	15	103	17	17
208. 2,4-Dinitrophenol	0	0	0	50	88	35	32	92
209. 4,6-Dinitro-2-cresol	15	25	170	50	17	86	19	23
210. Pentachlorophenol	64	31	48	50	14	114	16	14
211. 4-Nitrophenol	31	29	95	50	23	72	10	15

a. Calculated from 7 data points

b. Calculated from 14 data points

Table B-7

COMPARISON OF QUALITY ASSURANCE DATA

Acids

Compound	Cincinnati				St. Louis			
	Method Ref. Std.[a]		Raw Wastewater Spike[b]		Method Ref. Std.[c]		Raw Wastewater Spike[d]	
	$\overline{P}$	Sp	$\overline{P}$	Sp	$\overline{P}$	Sp	$\overline{P}$	Sp
201. 2-Chlorophenol	86	29	93	29	92	12	106	17
202. 2-Nitrophenol	105	20	110	22	105	17	114	23
203. Phenol	77	12	62	26	71	11	72	15
204. 2,4-Dimethylphenol	80	18	93	17	77	12	99	20
205. 2,4-Dichlorophenol	93	30	108	19	104	11	123	21
206. 2,4,6-Trichlorophenol	98	21	108	18	95	11	111	17
207. 4-Chloro-3-cresol	114	13	124	12	95	11	103	17
208. 2,4-Dinitrophenol	94	24	107	26	0	0	35	32
209. 4,6-Dinitro-2-cresol	92	42	110	26	15	25	86	19
210. Pentachlorophenol	88	32	114	11	64	31	114	16
211. 4-Nitrophenol	56	48	21	42	31	29	72	10

a. Calculated from 15 data points

b. Calculated from 30 data points

c. Calculated from 7 data points

d. Calculated from 14 data points

dinitrophenols appeared to be dependent on the amount of phosphoric acid present (used to deactivate the polyester GC packing). During the Cincinnati study, good data for these two compounds were obtained when the glass wool was soaked in a phosphoric acid/acetone solution. However, D_{10}-anthracene exchanged when large quantities of acid were present. Therefore, use of D_{10}-anthracene as an internal standard for quantifying the acid priority pollutants was difficult. The QC data for the two dinitrophenol compounds were better for the raw wastewater spikes than the method reference standards (clean water spikes); this may be due to a more acidic sample matrix. In addition, the QC data for 4-nitrophenol in the raw wastewater spikes showed improvement over the Cincinnati data.

Base Neutrals Method

The GC column packing used in the GC/MS analysis for St. Louis was different from that used for the Cincinnati study. The concentrated extract was chromatographed onto a glass 6 ft x 2 mm ID gas chromatographic column packed with 3% SP 2250 DB on 100/120 Supelcoport. The column was temperature programmed from 50°C (isothermal, 4 minutes) to 265°C (isothermal, 20 minutes). This GC column was used rather than the 1% SP 2250 GC column because EPA[5] had reported that the chromatography of benzidine was improved.

The reporting limits for three of the base/neutral priority pollutants have improved as compared with the reporting limits used for the Cincinnati study. These three pollutants are: hexachloroethane (Cincinnati 20 µg/L, St. Louis 10 µg/L),and fluoranthene and pyrene (Cincinnati 10 µg/L, St. Louis 5 µg/L). The reporting limit for benzidine increased from 20 µg/L to 40 µg/L. The 3% SP 2250 DB GC column apparently offered no significant advantages as compared to the 1% SP 2250 GC column. It is believed that the benzidine problem was not due to the chromatography as much as it was due to the instability of benzidine in methylene chloride.

Eleven of the calibration curves determined for the St. Louis study were different from the curves determined from the Cincinnati study. These eleven compounds are: hexachloroethane, n-nitrosodi-n-propylamine, nitrobenzene, napthalene, dibenz(a,h)anthracene, benzo(g,h,i,) perylene, hexachlorobenzene, fluoranthene, pyrene, benzo(a)pyrene and benzidine. Eleven of the thirteen base/neutral priority pollutants not available for the Cincinnati study were available for the St. Louis study. Calibration data and quality control data have been included for these pollutants. Base/neutral calibration data is given in Table B-8.

Table B-9 presents the quality control data obtained during the St. Louis study for the individual base/neutral pollutants. Table B-10 presents the quality control data from both the Cincinnati and St. Louis studies. Overall, the quality control data from St. Louis was comparable with the Cincinnati data.

Several base neutral compounds that were problematic in the Cincinnati study were still problematic during the St. Louis study:

Compound	Problem
Bis(chloromethyl)ether	Very short half-life in water
Hexachlorocyclopentadiene	High GC/MS detection limit
Benzidine	High GC/MS detection limit, heat liable, unstable in CH_2Cl_2.

Two compounds that were not included in the Cincinnati study were found to be problematic during the St. Louis study:

N-nitrosodimethylamine	Poor chromatography (peak tailing and broadening), therefore high detection limit.
2-Chloroethylvinyl ether	Volatile (bp 109°C), probably should be analyzed by the method for volatiles

The quality control data for the other eight compounds included in St. Louis and not Cincinnati were quite good.

The precision for several of the compounds, especially in the PAH category, improved substantially compared to that achieved in the Cincinnati study.

Table B-8

CALIBRATION VALUES FOR CONCENTRATION CALCULATION

Base/Neutrals

	Compound	RRT [a]	Slope [b]	Intercept	Reporting Limit	
					Rel. Area	ng
301.	1,3 Dichlorobenzene	.305	5.1340	27.3980	0.505	30
302.	1,4 Dichlorobenzene					
303.	1,2 Dichlorobenzene					
304.	Hexachloroethane	.335	16.0445	6.1432	0.2400	10
305.	Bis(chloromethyl)ether	–	–	–	–	ND
306.	Bis(2–chloroethyl) ether	.385	4.9240	10.3330	1.9600	20
307.	Bis(2–chloroisopropyl) ether	.382	2.3624	2.1743	3.3100	10
308.	N–Nitrosodimethylamine	.567	21.8524	32.7404	0.3300	40
309.	Nitrosodi-n-propylamine	.578	61.1540	10.4325	0.1550	20
310.	Nitrobenzene	.506	7.1434	15.1044	0.6800	20
311.	Hexachlorobutadiene	.492	15.5780	6.5760	0.2190	10
312.	1,2,4–Trichlorobenzene	.506	7.5980	9.3900	1.3900	20
313.	2–Chloroethyl vinyl ether	–	–	–	–	ND
314.	Bis(2–chloroethoxy) methane	.559	6.5451	13.2081	1.0350	20
315.	Naphthalene	.530	2.9195	2.4782	2.5700	10
316.	Isophorone	.560	2.4040	6.1810	1.5800	10
317.	Hexachlorocyclopentadiene	–	–	–	–	ND
318.	2–Chloronaphthalene	.697	5.0310	3.0100	1.3800	10
319.	Acenaphthylene	.763	3.7060	2.0900	2.1300	10
320.	Acenaphthene	.781	5.8330	0.7300	1.5880	10
321.	Dimethyl phthalate	.813	5.0000	-0.3020	2.0600	10
322.	2,6–Dinitrotoluene	.821	28.8350	2.0960	0.2740	10
323.	4–Chlorophenyl phenyl ether	.851	7.4233	-1.3493	1.5250	10
324.	Fluorene	.853	5.7450	-0.5850	1.8400	10
325.	2,4–Dinitrotoluene	.872	20.7320	4.0470	0.2870	10
326.	Diethyl phthalate	.885	5.2180	-5.1340	2.9000	10
327.	1,2–Diphenylhydrazine	.879	3.3140	0.5000	2.8600	10
328.	N–Nitrosodiphenylamine	.905	15.3781	6.8918	0.2000	10
329.	Hexachlorobenzene	.918	18.8973	1.0073	0.4750	10
330.	4–Bromophenyl phenyl ether	.922	21.1108	-0.2376	0.4840	10

Table B-8 (cont'd)

CALIBRATION VALUES FOR CONCENTRATION CALCULATION

Base/Neutrals

Compound		RRT [a]	Slope [b]	Intercept	Reporting Limit	
					Rel. Area	ng
331.	Anthracene	1.000	4.8260	-3.8920	2.870	10
332.	Phenanthrene					
333.	Di-n-butyl phthalate	1.085	3.2770	-6.8990	5.1550	10
334.	Fluoranthene	1.170	4.3106	1.6476	0.7770	5
335.	Pyrene	1.206	3.5177	1.0758	1.1150	5
336.	Benzidine	1.300	19.7230	35.3490	0.2360	40
337.	Butyl benzyl phthalate	1.317	7.5862	5.2806	0.6200	10
338.	Bis(2–ethylhexyl) phthalate	1.350	5.0970	-4.6540	2.8740	10
339.	Di-n-octyl phthalate					
340.	Chrysene	1.390	7.2510	1.9070	1.1150	10
341.	Benzo(a)anthracene					
342.	3,3'–Dichlorobenzidine	1.427	19.8672	18.4898	0.0750	20
343.	Benzo(b)fluoranthene	1.547	5.4528	0.7398	0.7800	5
344.	Benzo(k)fluoranthene					
345.	Benzo(a)pyrene	1.620	5.5121	1.2679	0.6750	5
346.	Indeno (1,2,3–c,d) pyrene	1.979	5.0705	1.5579	0.6750	5
347.	Dibenzo (a,h) Anthracene	1.992	13.8678	2.1597	0.2040	5
348.	Benzo (g,h,i) perylene	2.111	11.1359	2.1626	0.2540	5

a. Retention time, relative to d_{10}-anthracene, 21.39 minutes.

b. X = response, Y = concentration.

Table B- 9

QUALITY CONTROL DATA

Base/Neutrals

Compound		Method Reference [a]			Raw Wastewater [b]				
		$\overline{P}$	Sp	%Sp	C	R_c	$\overline{P}$	Sp	%Sp
301.	1,3 Dichlorobenzene	64	19	30	149	119	58	13	23
302.	1,4 Dichlorobenzene								
303.	1,2 Dichlorobenzene								
304.	Hexachloroethane	71	25	34	50	35	73	20	28
305.	Bis(chloromethyl)ether	–	–	–	–	–	–	–	–
306.	Bis(2–chloroethyl) ether	59	31	53	50	38	70	27	39
307.	Bis(2–chloroisopropyl) ether	c					c		
308.	N–Nitrosodimethylamine	–	–	–	–	–	–	–	–
309.	Nitrosodi-n-propylamine	93	19	20	48	26	102	26	26
310.	Nitrobenzene	79	42	53	50	29	99	28	28
311.	Hexachlorobutadiene	60	14	24	50	32	55	11	20
312.	1,2,4–Trichlorobenzene	75	14	19	50	24	82	14	18
313.	2–Chloroethyl vinyl ether	–	–	–	–	–	–	–	–
314.	Bis(2–chloroethoxy) methane	85	17	20	50	34	93	41	44
315.	Naphthalene	79	25	32	51	45	86	31	36
316.	Isophorone	61	17	27	49	30	69	17	25
317.	Hexachlorocyclopentadiene	–	–	–	–	–	–	–	–
318.	2–Chloronaphthalene	86	18	22	52	38	81	19	23
319.	Acenaphthylene	85	17	20	52	40	80	17	21
320.	Acenaphthene	90	18	20	50	40	82	19	24
321.	Dimethyl phthalate	62	18	28	50	64	70	27	39
322.	2,6–Dinitrotoluene	90	15	17	50	38	81	20	24
323.	4–Chlorophenyl phenyl ether	86	23	26	50	51	65	19	29
324.	Fluorene	90	14	16	51	40	74	16	21
325.	2,4–Dinitrotoluene	104	15	15	50	44	57	21	37
326.	Diethyl phthalate	77	18	23	50	47	94	27	29
327.	1,2–Diphenylhydrazine	84	20	24	50	36	65	17	26
328.	N–Nitrosodiphenylamine	140	14	10	50	45	156	34	22
329.	Hexachlorobenzene	80	11	14	50	42	63	16	26
330.	4–Bromophenyl phenyl ether	92	10	11	50	47	60	17	29

Table B-9 (cont'd)

QUALITY CONTROL DATA

Base/Neutrals

Compound	Method Reference [a]			Raw Wastewater [b]				
	$\overline{P}$	Sp	%Sp	C	R_c	$\overline{P}$	Sp	%Sp
331. Anthracene	107	11	10	100	94	86	20	23
332. Phenanthrene								
333. Di-n-butyl phthalate	96	15	16	50	137	69	56	81
334. Fluoranthene	86	2	2	25	20	63	14	22
335. Pyrene	87	4	5	25	21	64	16	25
336. Benzidine	-	-	-	-	-	-	-	-
337. Butyl benzyl phthalate	75	9	12	50	54	47	15	33
338. Bis(2-ethylhexyl) phthalate	52	12	23	100	79	50	14	29
339. Di-n-octyl phthalate								
340. Chrysene	77	11	14	55	39	70	13	19
341. Benzo(a)anthracene								
342. 3,3'-Dichlorobenzidine	76	24	32	50	30	104	25	24
343. Benzo(b)fluoranthene	57	40	69	7	23	52	48	93
344. Benzo(k)fluoranthene								
345. Benzo(a)pyrene	68	7	10	27	22	63	15	23
346. Indeno (1,2,3-c,d) pyrene	c					c		
347. Dibenzo (a,h) Anthracene	69	17	24	25	25	64	19	29
348. Benzo (g,h,i) perylene	75	15	20	25	21	67	16	24

a. Calculated from 7 data points

b. Calculated from 14 data points

c. Standard not available for spiking solution

Table B-10

COMPARISON OF QUALITY ASSURANCE DATA

Base/Neutrals

	COMPOUND	CINCINNATI				ST. LOUIS			
		METHOD REF. STD. [a]		RAW WASTEWATER SPIKE [b]		METHOD REF. STD. [c]		RAW WASTEWATER SPIKE [d]	
		$\bar{P}$	Sp	$\bar{P}$	Sp	$\bar{P}$	Sp	$\bar{P}$	Sp
301.	1,3 Dichlorobenzene	74	23	81	19	64	19	58	13
302.	1,4 Dichlorobenzene								
303.	1,2 Dichlorobenzene								
304.	Hexachloroethane	66	25	71	21	71	25	73	20
305.	Bis(chloromethyl) ether	-	-	-	-	-	-	-	-
306.	Bis(2-chloroethyl) ether	72	29	79	28	59	31	70	27
307.	Bis(2-chloroisopropyl) ether	e		e		e		e	
308.	N-Nitrosodimethylamine	e		e		-	-	-	-
309.	Nitrosodi-n-propylamine	63	11	72	17	93	19	102	26
310.	Nitrobenzene	71	26	76	22	79	42	99	28
311.	Hexachlorobutadiene	83	23	69	16	60	14	55	11
312.	1,2,4-Trichlorobenzene	79	21	81	16	75	14	82	14
313.	2-Chloroethyl vinyl ether	e		e		-	-	-	-
314.	Bis(2-chloroethoxy) methane	e		e		85	17	93	41
315.	Naphthalene	78	16	86	18	79	25	86	31
316.	Isophorone	80	23	85	26	61	17	69	17
317.	Hexachlorocyclopentadiene	-	-	-	-	-	-	-	-
318.	2-Chloronaphthalene	104	21	105	19	86	18	81	19
319.	Acenaphthylene	102	20	109	23	85	17	80	17
320.	Acenaphthene	109	19	103	18	90	18	82	19
321.	Dimethyl phthalate	71	44	91	36	62	18	70	27
322.	2,6-Dinitrotoluene	132	25	132	33	90	15	81	20
323.	4-Chlorophenyl phenyl ether	e		e		86	23	65	19
324.	Fluorene	124	26	107	22	90	14	74	16
325.	2,4-Dinitrotoluene	128	45	96	41	104	15	57	21
326.	Diethyl phthalate	118	39	108	28	77	16	94	27
327.	1,2-Diphenylhydrazine	108	30	96	27	84	20	65	17

Table B-10(cont'd)

COMPARISON OF QUALITY ASSURANCE DATA

Base/Neutrals

COMPOUND	CINCINNATI				ST. LOUIS			
	METHOD REF. STD. [a]		RAW WASTEWATER SPIKE [b]		METHOD REF. STD. [c]		RAW WASTEWATER SPIKE [d]	
	$\bar{P}$	Sp	$\bar{P}$	Sp	$\bar{P}$	Sp	$\bar{P}$	Sp
328. N-Nitrosodiphenylamine	e		e		140	14	156	34
329. Hexacholorobenzene	135	54	92	40	80	11	63	16
330. 4-Bromophenyl phenyl ether	e		e		92	10	60	17
331. Anthracene	125	26	93	21	107	11	86	20
332. Phenanthrene								
333. Di-n-butyl phthalate	128	46	67	28	96	15	69	56
334. Fluoranthene	154	42	80	28	86	2	63	14
335. Pyrene	157	48	86	30	87	4	64	16
336. Benzidine	43	32	37	41	-	-	-	-
337. Butyl benzyl phthalate	e		e		75	9	47	15
338. Bis(2-ethylhexyl) phthalate	80	53	37	31	52	12	50	14
339. Di-n-octyl phthalate	e		e					
340. Chrysene	117	51	63	19	77	11	70	13
341. Benzo(a)anthracene								
342. 3,3'-Dichlorobenzidine	e		e		76	24	104	25
343. Benzo(b)fluoranthene	e		e	e	57	40	52	48
344. Benzo(k)fluoranthene								
345. Benzo(a)pyrene	89	46	59	20	68	7	63	15
346. Indeno(1,2,3-c,d,) pyrene	e		e		e		e	
347. Dibenzo(a,h) anthracene	74	42	57	34	69	17	64	19
348. Benzo(g,h,i)perylene	75	48	53	39	75	15	67	16

a. Calculated from 15 data points.
b. Calculated from 30 data points.
c. Calculated from 7 data points.
d. Calculated from 14 data points.
e. Standards not available for spiking solution

Pesticides and PCBs

The analysis procedure was somewhat modified for the St. Louis study.

An internal standard, tetrachlorotetrahydronaphthalene, was added to the concentrated florisil eluents to give a concentration level of 0.4 ng/μL of the extract. These samples were analyzed using a Hewlett-Packard 5840A gas chromatograph equipped with a ^{63}Ni electron capture detector (ECD). The column used for the analysis was a 6 ft. x 4 mm I.D. silane treated glass column packed with 1.5% SP 2250/1.95% SP 2401 on 100/120 Supelcoport. The column temperature was 200°C and the temperature of the EC detector was 300°C. The carrier gas was 95% Argon/5% methane at a flow rate of 75 mL/min.

A second GC column packed with the same material, but in a narrower bore glass column was used to corroborate the preliminary indentifications. This second GC column was a 6 ft. x 2 mm I.D. silane-treated glass column packed with 1.5% SP 2250/1.95% SP 2401 on 100/120 mesh Supelcoport. The column temperature was 180°C (isothermal). The carrier gas was 95% Argon/5% methane at a flow rate of 30 mLs/min.

Table B-11 lists the relative retention times of the sixteen pesticides on the two GC columns. Table B-12 lists the relative retention times of the major GC peaks attributable to each of the seven PCBs. If priority pollutant pesticides or PCBs were detected in a sample by GC/ECD on both the GC columns, the identity was confirmed by GC/MS. Table B-13 lists typical calibration values used for the concentration calculations. Calibration standards were analyzed daily.

The two modifications incorporated in this method simplified the overall procedure: GC peak identification was simplified by the addition of the internal standard to the concentrated Florisil eluents, and the number of GC/MS analyses were decreased by the second GC column confirmation analysis.

Table B-11

RELATIVE RETENTION TIMES

Pesticides

	4mm [a] 1.5% SP 2250 1.95% SP 2401	2mm [b] 1.5% SP 2250 1.95% SP 2401
Alpha-BHC	.478	0.402
Gamma-BHC	.593	0.525
Beta-BHC	.675	0.630
Heptachlor	.714	0.664
Delta-BHC	.778	0.741
Aldrin	.853	0.819
Tetrachlorotetrahydro-naphthalene (IS)	1.000	1.000
Heptachlor Epoxide	1.264	1.308
Endosulfan I	1.575	1.665
DDE	1.803	2.081
Dieldrin	1.932	2.248
Endrin	2.253	2.601
DDD	2.850	3.137
Endosulfan II	2.850	3.137
DDT	3.250	3.338
Endrin Aldehyde	3.771	3.660
Endosulfan Sulfate	4.661	4.442

a. Retention time relative to internal standard tetrachlorotetrahydronaphthalene (3.00 minutes).

b. Retention time relative to internal standard tetrachlorotetrahydronaphthalene (6.30 minutes).

Table B-12

RELATIVE RETENTION TIMES [a]

PCBs

PCB 1016	PCB 1221	PCB 1232	PCB 1242	PCB 1254	PCB 1248	PCB 1260
0.445	0.279	0.446	0.445	1.489	0.554	1.326
0.554	0.445	0.558	0.554	2.2590	0.706	1.460
0.706	0.558	0.706	0.706	2.5324	0.873	2.022
0.768	0.707	0.286	0.876	3.2626	1.094	2.243
0.877	1.282	4.150	1.094	4.125	1.282	2.533
1.21			1.283		1.504	2.859
1.282			1.504		1.844	3.232
			1.844		1.978	3.475
			1.982		2.246	4.232
			2.246		2.862	5.047

[a] Relative to tetrachlorotetrahydronaphthalene, 3.00 minutes, on 6 ft x 4 mm column, 1.5% SP 2250/1.95% SP 2401 on 100/120 Supelcoport, with 95% argon/5% methane at 75 mL/min.

Table B- 13

CALIBRATION DATA

Pesticides

Sample Number and Compound	Slope	Intercept	Reporting Limit µg/L
400. Tetrachlorotetrahydronaphthalene, IS			
401. alpha-BHC	7.3690	.0337	1
402. gamma-BHC	7.077	.0523	1
403. Heptachlor	8.5138	.0613	1
404. beta-BHC	8.3602	.0506	1
405. delta-BHC	5.6961	.0257	1
406. Aldrin	7.5566	.0541	1
407. Heptachlor epoxide	10.1106	.1552	1
408. Endosulfan I.	4.7915	.0565	1
409. DDE	8.0095	.1374	1
410. Dieldrin	10.1127	.1470	1
411. Endrin	12.3536	.1871	1
412. DDD	9.9161	.1265	1
413. Endosulfan II			
414. DDT	10.5982	.1025	1
423. PCB–1254	.284	.0586	1

PCB 1254 was the only PCB added to the QC samples during the St. Louis study. High recovery and good precision results were observed for PCB 1254 at 90 µg/L when the pesticides were spiked at 10 µg/L (average). These data are representative of the precision and accuracy obtainable for the other six priority pollutant PCBs and chlordane and toxaphene when this procedure is used.

The QC data obtained at the lower spiking concentration value (10 µg/L) was comparable to the data obtained during the Cincinnati study at 30 µg/L. Table B-14 presents the quality control data from St. Louis. Table B-15 presents a comparison of the quality control data from Cincinnati and St. Louis.

Total Cyanides Method

Table B-16 provides a direct comparison of Cincinnati and St. Louis quality control data. The data from the two cities are comparable and good. The reporting limit used for the St. Louis data was lowered from 20 µg/L to 10 µg/L.

Total Phenols Method

Table B-17 includes the comparison of St. Louis and Cincinnati QC data for total phenols. The data from the two cities are comparable and good. The total phenols reporting limit was 20 µg/L.

Metals Method

For the St. Louis study, the metallic priority pollutants were analyzed by atomic adsorption spectroscopy and plasma emission spectroscopy. The atomic adsorption spectroscopy procedures used to analyze mercury, arsenic, beryllium, cadmium, antimony, selenium, and thallium have been described in the Cincinnati report.[3]

Seven of the metals, (chromium, copper, manganese, nickel, lead, silver and zinc) were anlyzed using Direct Current Plasma Optical Emission

Table B-14

QUALITY CONTROL DATA

Pesticides

Compound	Method Reference Standard [a]			Raw Wastewater [b]				
	$\overline{P}$	Sp	%Sp	C	R_c	$\overline{P}$	Sp	%Sp
401. alpha-BHC	86	14	16	10	7	81	15	18
402. gamma-BHC	86	15	18	11	6	84	14	17
403. beta-BHC	52	27	51	12	22	42	29	70
404. Heptachlor	98	36	37	10	5	88	25	28
405. delta-BHC	79	14	17	10	10	90	28	31
406. Aldrin	74	17	23	10	3	74	14	20
407. Heptachlor epoxide	72	20	28	10	4	72	13	18
408. Endosulfan I.	66	24	37	10	22	55	28	51
409. DDE	85	24	28	11	5	85	13	16
410. Dieldrin	68	22	33	10	10	44	17	39
411. Endrin	71	21	30	10	9	72	17	24
412. DDD	66	23	34	10	6	65	20	31
413. Endosulfan II								
414. DDT	93	18	19	9	5	74	15	21
423. PCB–1254	89	12	14	90	69	83	14	17

a. Calculated from 8 data points.

b. Calculated from 16 data points.

Table B-15

COMPARISON OF QUALITY ASSURANCE DATA

Pesticides

Compound	CINCINNATI				ST. LOUIS			
	Method Ref.Std[a]		Raw Waste-water Spike[b]		Method Ref.Std.[c]		Raw Waste-water Spike[d]	
	$\overline{P}$	Sp	$\overline{P}$	Sp	$\overline{P}$	Sp	$\overline{P}$	Sp
401. alpha-BHC	83	6	79	10	86	14	81	15
402. gamma-BHC	82	8	77	9	86	15	84	14
403. beta-BHC	76	7	71	13	52	27	42	29
404. Heptachlor	79	22	67	28	98	36	88	25
405. delta-BHC	77	9	70	19	79	14	90	28
406. Aldrin	74	7	70	10	74	17	74	14
407. Heptachlor epoxide	82	6	76	10	72	20	72	13
408. Endosulfan I.	57	11	62	19	66	24	55	28
409. DDE	70	14	69	18	85	24	85	13
410. Dieldrin	68	8	63	14	68	22	44	17
411. Endrin	56	15	54	14	71	21	72	17
412. DDD	73	11	66	10	66	23	65	20
413. Endosulfan II								
414. DDT	72	15	70	15	93	18	74	15
423. PCB–1254	–	–	–	–	89	12	83	14

a. Based on 15 data points, spiked at 30 μg/L.
b. Based on 30 data points, spiked at 30 μg/L.
c. Based on 8 data points, spiked at 10 μg/L.
d. Based on 16 data points, spiked at 10 μg/L.

Table B-16

QUALITY CONTROL DATA

Total Cyanides/Total Phenols

COMPOUND	METHOD REF. STANDARD [a]			RAW WASTEWATER SPIKES [b]				
	P	Sp	% Sp	C	R_c	P	Sp	% Sp
601. Total Cyanides	100	9	9	20	4.3	96	13.6	14.1
602. Total Phenols	87	8	9	60	17	101	14	14

a. Calcualted from 8 data points

b. Calculated from 16 data points

Table B-17

COMPARISON OF QUALITY ASSURANCE DATA

Total Cyanides/Total Phenols

COMPOUND	CINCINNATI				ST. LOUIS			
	Method Ref. Std.[a]		Raw Waste-water [b]		Method Ref. Std.[c]		Raw Waste-water [d]	
	$\overline{P}$	Sp	$\overline{P}$	Sp	$\overline{P}$	Sp	$\overline{P}$	Sp
601. Total Cyanides	103	6	101	12	100	9	96	13.6
602. Total Phenols	107	13	93	15	87	8	101	14

a. Calculated from 15 data points

b. Calculated from 30 data points

c. Calculated from 8 data points

d. Calculated from 16 data points

spectroscopy (DCPOES), rather than flameless atomic adsorption spectroscopy that was used for Cincinnati samples. Lithium was added to these samples to a concentration level of 1,000 ppm, as an ionization buffer. A spectraspan III Plasma Emission Spectrometer (Spectrametrics, Inc., Andover, Mass.) equipped with a Spectrajet III three legged DC argon plasma excitation source was used for all DCPOES analyses. Calibration standards were prepared by volumetrically diluting 1,000 ppm aqueous standard solutions (Spex Industries, Inc.) and adding 1,000 ppm lithium. Standards were analyzed before and after every two samples to correct for any instrument drift.

The reporting limits calculated for the St. Louis study improved as compared with the Cincinnati study (Table B-18). The improvement was especially notable for those compounds where plasma emission spectroscopy (PES) was used rather than flameless atomic absorption spectroscopy. Table B-19 presents the metals quality control data from the St. Louis study. Table B-20 presents the comparison QC data from St. Louis and Cinci-nati. The QC data from St. Louis was substantially improved over Cincinnati data especially for those metals analyzed by PES rather than FAAS.

Field Blanks

Two field blanks were also analyzed for all the priority pollutants to determine the extent of any possible contamination. The concentration data for these samples is presented in Table B-21.

Table B-18

REPORTING LIMITS (μg/L)

Metals

Sample Number and Compound	St. Louis Procedure[a]	Raw Wastewater Reporting Limits	
		St. Louis	Cincinnati
501. Antimony	FAAS	3	3
502. Arsenic	FAAS	3	4
503. Beryllium	FAAS	1	3
504. Cadmium	FAAS	1	3
505. Chromium	PES	3	27
506. Copper	PES	4	9
507. Lead	PES	3	6
508. Manganese	PES	4	11
509. Mercury	FAAS	2	1
510. Nickel	PES	2	9
511. Selenium	FAAS	3	2
512. Silver	PES	2	1
513. Thallium	FAAS	1	1
514. Zinc	PES	16	12

a. FAAS = Flameless Atomic Adsorption Spectroscopy
PES = Plasma Emission Spectroscopy

Table B- 19

QUALITY ASSURANCE DATA

Metals

METAL	Method Reference[a]			Raw Wastewater[b]				
	$\overline{P}$	Sp	%Sp	C	Rc	$\overline{P}$	Sp	%Sp
501. Antimony	41	8	20	10	12	89	43	48
502. Arsenic	66	3	4	25	16	101	36	36
503. Beryllium	129	11	9	10	2	88	11	12
504. Cadmium	75	8	10	10	3	79	20	25
505. Chromium	98	2	2	100	8	100	4	4
506. Copper	97	4	4	50	16	104	10	9
507. Lead	99	3	3	50	12	103	11	10
508. Manganese	100	0.4	0.3	100	21	97	6	6
509. Mercury	98	52	53	10	14	94	32	34
510. Nickel	102	3	3	50	8	104	6	6
511. Selenium	88	13	15	10	6	125	51	41
512. Silver	93	9	10	10	4	114	23	20
513. Thallium	101	6	6	10	1	108	15	14
514. Zinc	102	5	5	100	116	126	57	45

a. Calculated from 8 data points.

b. Calculated from 16 data points, except lead (14), and silver (12).

Table B-20

COMPARISON OF QUALITY ASSURANCE DATA

Metals

METAL	CINCINNATI (FAAS)					ST. LOUIS (PES)			
	Method Ref. Std[a]		Raw Wastewater[b]			Method Ref. Std[d]		Raw Wastewater[e]	
	$\overline{P}$	Sp	$\overline{P}$	Sp	$\%\overline{RP}$[c]	$\overline{P}$	Sp	P	Sp
501. Antimony	61	47	90	67	36	41	8	89	43
502. Arsenic	158	29	110	73	11	66	3	100	36
503. Beryllium	85	15	90	38	7	129	11	88	11
504. Cadmium	83	21	87	44	20	75	8	79	20
505. Chromium	129	189	182	425	10	98	2	100	4
506. Copper	207	177	83	323	11	97	4	104	10
507. Lead	165	152	67	95	29	99	3	103[f]	10
508. Manganese	143	98	185	143	4	100	.4	97	6
509. Mercury	59	31	42	40	12	98	52	94	32
510. Nickel	74	96	-22	436	60	102	3	104	6
511. Selenium	135	17	121	47	13	88	13	125	51
512. Silver	108	30	90	21	6	93	9	114[g]	23
513. Thallium	99	33	90	29	7	101	6	108	15
514. Zinc	254	344	92	554	11	102	5	126	57

a. Calculated from 15 data points.

b. Calculated from 30 data points.

c. $\%\overline{RP}$ = Ri/observed value x 100.

d. Calculated from 8 data points.

e. Calculated from 16 data points.

f. Lead - 14 data points.

g. Silver - 12 data points.

Table B-21

FIELD BLANK
PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
ORGANICS

SAMPLE NUMBER	128	143						Avg.
110. 1,1-Dichloroethylene	–	–						–
111. 1,1-Dichloroethane	–	–						–
112. Trans-1,2-dichloroethylene	–	–						–
113. Chloroform	–	–						–
114. 1,2-Dichloroethane	–	–						–
115. 1,1,1-Trichloroethane	–	–						–
116. Carbon tetrachloride	–	–						–
117. Bromodichloromethane	–	–						–
118. 1,2-Dichloropropane	–	–						–
119. Trans-1,3-dichloropropylene	–	–						–
120. Trichloroethylene	–	–						–
121. Benzene	1	–						0.5
123. Dibromochloromethane	–	–						–
125. Bromoform	–	–						–
127. 1,1,2,2-Tetrachloroethylene	2	1						1.5
128. Toluene	2	1						1.5
129. Chlorobenzene	–	–						–
130. Ethyl benzene	–	–						–
201. 2-Chlorophenol	–	–						–
203. Phenol	–	–						–
204. 2,4-Dimethylphenol	–	–						–
205. 2,4-Dichlorophenol	–	–						–
206. 2,4,6-Trichlorophenol	–	–						–
301. Dichlorobenzenes	–	–						–
315. Naphthalene	–	–						–
326. Diethyl phthalate	–	–						–
331. Anthracene/Phenanthrene	–	–						–
333. Di-n-butyl phthalate	12	–						6
335. Pyrene	–	–						–
337. Butyl benzyl phthalate	–	–						–
338. Bis (2-ethylhexyl) phthalate	–	–						–
406. Aldrin	–	–						–

Table B-21 (Cont'd)

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
METALS, CYANIDES, AND PHENOLS

FIELD BLANKS

SAMPLE NUMBER	128	143					Avg.
501. Antimony	–	–					–
502. Arsenic	–	–					–
503. Beryllium	–	–					–
504. Cadmium	–	–					–
505. Chromium	–	–					–
506. Copper	10	–					5
507. Lead	–	–					–
508. Manganese	–	–					–
509. Mercury	–	–					–
510. Nickel	3	–					1.5
511. Selenium	NA*	10					10
512. Silver	–	12					6
513. Thallium	–	–					–
514. Zinc	–	–					–
601. Total Cyanides	–	–					–
602. Total Phenols	–	–					–

* NA = Not Analyzed

Table B-21 (Cont'd)

CLASSICAL WASTEWATER PARAMETER ANALYSIS

Field Blanks

SAMPLE NUMBER	128	143						Avg.
pH	7.0	7.2						7.1
T (^{o}C)	7.6	13.0						10.3
Ammonia	2.1	0.1						1.1
Oil and Grease	5	-						3
TSS	-	-						-
TOC	7	3						5
COD	-	-						-
BOD	-	-						-

APPENDIX C

D_{10}-ANTHRACENE, INTERNAL STANDARD

The priority pollutant screening protocol published by EPA Cincinnati[1] calls for adding the D_{10}-anthracene internal standard to the methylene chloride solutions after the aqueous samples have been extracted and concentrated for acid and base/neutral priority pollutant analyses. For the Cincinnati and St. Louis studies, the D_{10} internal standard was added to the aqueous sample before extraction. If the D_{10} (along with the other compounds) were not being extracted completely from the aqueous samples, the compounds would show higher than usual recovery values when compared to the method of adding D_{10} to the extract. In effect, the D_{10} is acting as a total system internal standard, as it perhaps more appropriately should. By having a total system internal standard in this manner, one is assured of getting the most reliable source concentration data from priority pollutants. It is recognized that since this procedure is different from that used by most of the EPA Effluent Guidelines Division contractors following the priority pollutant screening protocol strictly, it is possible that the data obtained by the two types of procedures might not be directly comparable. To address that question, the data have been assembled from the St. Louis study for review. The data presented later in this Appendix show that D_{10} is extracted with nearly 100% efficiency from both the acidic and basic aqueous samples and thus no correction factors are necessary and data obtained with this technique are directly comparable to data obtained by adding the D_{10} after extraction.

It is normal for many quantitative analytical procedures to use an internal standard in order to improve the precision of the analytical result. For many instrument systems such as gas chromatographs or liquid chromatographs, the use of an internal standard frequently achieves a reduction in standard deviation from about 10% to 2%. These chromatographic systems inherently have high detector stability and thus have minimal need for the use of an internal standard, beyond the simple convenience associated with such standards. In the screening protocol using GC/MS, however, the use of an internal standard is critical to obtaining accurate concentration data for the priority pollutants.

In contrast to the detectors associated with the simpler gas and liquid chromatograph instruments, the mass spectrometer as a detector has a high variability in absolute source sensitivity. Thus, the only way to achieve quantitative results from a GC/MS system used in this type of broad spectrum screening mode is by using an internal standard. The D_{10} standard identified for the protocol is a convenient one in that minimum interferences occur with the use of this standard in the samples encountered thus far in this study. The D_{10} provides a basis for computing concentrations by comparing the response for given pollutants to the response for the D_{10} internal standard.

For each of the samples which have been analyzed, there is an area value corresponding to the GC/MS system response to the D_{10} in terms of absolute area counts. Table C-1 gives a listing of the sample types which have been analyzed in this program and shows the differences between them. Samples A, B, and C correspond to raw wastewater samples. A and B contain the priority pollutant spikes for the QC program, with C being the unknown sample. Samples D and F are high purity clean water: F containing no added materials except D_{10}, and D being the method reference standard containing the other priority pollutants. In addition, a completely independent calibration sample (E) of pollutants including D_{10} in methylene chloride is prepared.

The basic procedures for obtaining data from this program are summarized in Table C-2. In order to calibrate the GC/MS system, a series of calibration standards are run containing priority pollutants in various concentrations and containing D_{10} at a fixed concentration. The absolute areas of the D_{10} and each of the priority pollutants is measured, and the relative area response of priority pollutant to D_{10} is computed and calibration curves are prepared from this data. Similarly, each of the samples is analyzed, the D_{10} and priority pollutant areas measured, and the pollutant to D_{10} response ratio computed. By use of this data and the previously determined calibration curves, the priority pollutant concentrations can be calculated. Although the peak area data is never reported on an absolute basis either for D_{10} or any of the priority pollutants, this data is available in the information which was used to compute pollutant concentrations.

As reviewed in Table C-2, area counts for D_{10} are available from the independent calibration series (E), the raw wastewater samples (A, B,C), and the clean water series (D,F). Each of these samples is analyzed in some sequence during the course of the day. Since the GC/MS system response varies during the course of the day, there are two ways of analyzing the data available from the samples which have already been analyzed and whose results have already been reported. Basically, all of the D_{10} data for the E-type samples, the A,B,C-type samples, and the D,F-type samples has been summarized over an entire analysis set such as the entire set of samples extracted from the acid condition. A summary of these average values over the entire set assumes the fluctuation which occurred in the system response occurred equally for all sample types. Alternately, one can analyze the available data in higher resolution by taking the A,B,C and D,F data sets which were obtained in close time proximity to the E sample analysis. The data from the St. Louis samples has been reviewed using both of these techniques and is summarized in Table C-3.

Based on the technique of pooling all of the data for a given type of analysis set, i.e., acid or base/neutral, it is seen that the absolute D_{10} recovery values range from 90 to 95% for the acid extract and from 90 to 110% for the base/neutral extracts. The higher resolution time pairing data comparison approach shows similar values. For eight sets of data from the acid extracts, an average recovery of 91% is observed for the clean water samples and 95% for the raw wastewater samples. Similarly, for nine data sets with the base/neutral extracts, the average recovery is 100% for clean water and 101% for raw wastewater.

We believe these data demonstrate clearly that the d_{10}-anthracene is being extracted with 100% efficiency and that the data previously reported for recoveries of other priority pollutants are valid as given and do not require any correction factor for comparison with other studies.

Table C-1

D_{10}-ANTHRACENE: SAMPLE TYPES and TREATMENT

A - } Raw Waste Water
B - } Raw Waste Water
C - } Raw Waste Water
D - Method Reference Sample, Clean Water
E - Calibration Standard
F - Blank, Clean Water

E

CH_2Cl_2
↓
Add D_{10}
↓
Calibrate

A,B,C

Raw Waste Water
↓
Spike D_{10}
↓
Extract (CH_2Cl_2)
↓
Concentrate
↓
Analyse

D,F

Clean Water
↓
Spike D_{10}
↓
Extract (CH_2Cl_2)
↓
Concentrate
↓
Analyse

Table C-2

CALIBRATION AND ANALYSIS DATA AND PROCEDURES

CALIBRATION STANDARD (E)

Run GC/MS

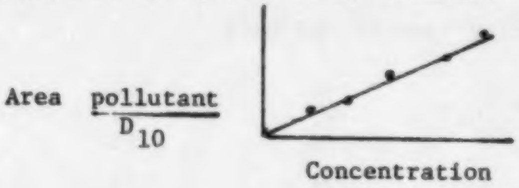
*Measure D_{10} area (D_{10} concentration constant - 5μg/L)

Measure pollutant areas (series of concentration, 10 - 100μg/L)

Calculate pollutant/D_{10} ratios

Construct calibration curves

Compute least squares line, detection limits



SAMPLES - RWW(A,B,C) and CW(D,F)

Run GC/MS

*Measure D_{10} area (spiked at 5μg/L)

Measure pollutant areas

Calculate pollutant/D_{10} ratios

Compute pollutant concentration from calibration data

* Absolute values of D_{10} areas available at these points

Table C-3

SUMMARY OF D_{10} COMPUTED RECOVERIES

St. Louis Data Base

1. Based on Average of All D_{10} Data

Extract	Clean Water (12)* D.F	RWW(82) A,B,C	Overall (94)
Acid	95.4% (12)*	90.0% (82)	90.4% (94)
Base/Neutral	110% (16)	89.8% (81)	93% (97)

* Number of data points for calculation

2. Based on Close Proximity Time Paired Data

Acid

Jan. 5	72%	95%
Jan. 8	60	105
Jan. 9	78	86
Jan. 10	104	96
Jan. 11	102	102
Jan. 12	90	110
Jan. 15	111	72
Jan. 16	110	95
Avg.	90.9%	95.1%

Base/Neutral

Feb. 1	113	111
Feb. 5	97	100
Feb. 6	78	90
Feb. 7	96	93
Feb. 8	68	52
Feb. 16	146	98
Feb. 17	161	196
Feb. 20	67	80
Feb. 21	78	93
Avg.	100.4%	101.4%

APPENDIX D

ANALYTICAL DATA BY SITE

This appendix contains the results of the chemical analyses for all the samples obtained in St. Louis. The data have been organized by site. Each sample represents a 24-hour collection period; the increments were flow composited to produce the final sample. In addition, the average presented for each chemical is a flow-weighted average of the individual samples obtained for each day.

The data for the organics, metals, total cyanides, and total phenols (100-300, 500, and 600 series) are given in μg/L; the data on the classical parameters (700 series) are presented in mg/L. Only those compounds detected at least once in the St. Louis samples have been included in these tables.

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
ORGANICS

EPPINGHAM

SAMPLE NUMBER		103	114	124	135	146	157		Avg.
110.	1,1-Dichloroethylene	–	–	–	–	–	–		–
111.	1,1-Dichloroethane	–	–	–	–	–	–		–
112.	Trans-1,2-dichloroethylene	–	–	–	–	–	–		–
113.	Chloroform	2	3	3	4	3	2		2.9
114.	1,2-Dichloroethane	–	–	–	–	–	–		–
115.	1,1,1-Trichloroethane	–	–	26	–	–	–		4.6
116.	Carbon tetrachloride	–	–	–	–	–	–		–
117.	Bromodichloromethane	–	–	–	–	–	–		–
118.	1,2-Dichloropropane	–	–	–	–	–	–		–
119.	Trans-1,3-dichloropropylene	–	–	–	–	–	–		–
120.	Trichloroethylene	–	–	–	–	–	–		–
121.	Benzene	–	–	2	1	1	–		0.7
123.	Dibromochloromethane	–	–	–	–	–	–		–
125.	Bromoform	–	–	–	–	–	–		–
127.	1,1,2,2-Tetrachloroethylene	3	6	77	9	8	21		21.3
128.	Toluene	3	4	2	2	1	1		2.1
129.	Chlorobenzene	–	–	–	–	–	–		–
130.	Ethyl benzene	–	–	–	–	–	–		–
201.	2-Chlorophenol	–	–	–	–	–	–		–
203.	Phenol	–	–	–	–	11	–		2.1
204.	2,4-Dimethylphenol	–	–	–	–	–	–		–
205.	2,4-Dichlorophenol	–	–	–	–	–	–		–
206.	2,4,6-Trichlorophenol	–	–	–	–	–	–		–
301.	Dichlorobenzenes	–	–	–	–	–	–		–
315.	Naphthalene	–	–	–	–	–	–		–
326.	Diethyl phthalate	19	21	21	19	–	–		13.3
331.	Anthracene/Phenanthrene	–	–	–	–	–	–		–
333.	Di-n-butyl phthalate	–	40	12	–	–	–		8.5
335.	Pyrene	–	–	–	–	–	–		–
337.	Butyl benzyl phthalate	12	12	13	15	13	14		13.2
338.	Bis (2-ethylhexyl) phthalate	–	–	16	–	–	–		2.9
406.	Aldrin	–	–	–	–	–	–		–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
METALS, CYANIDES, AND PHENOLS

EPPINGHAM

SAMPLE NUMBER		103	114	124	135	146	157		Avg.
501.	Antimony	10	9	24	11	12	8		12.6
502.	Arsenic	–	–	–	–	–	–		–
503.	Beryllium	–	–	–	–	–	–		–
504.	Cadmium	–	–	–	8	–	–		1.4
505.	Chromium	6	6	5	32	7	6		10.5
506.	Copper	30	30	33	32	30	30		30.9
507.	Lead	52	52	52	50	73	50		55.3
508.	Manganese	160	170	230	250	170	210		199
509.	Mercury	–	–	–	3	–	–		0.5
510.	Nickel	8	8	8	21	7	6		9.7
511.	Selenium	8	8	9	7	7	8		7.8
512.	Silver	8	–	–	–	18	–		4.6
513.	Thallium	–	–	–	–	–	–		–
514.	Zinc	85	170	86	89	120	63		103
601.	Total Cyanides	–	–	–	–	–	–		–
602.	Total Phenols	20	28	16	34	24	101		35.7

CLASSICAL WASTEWATER PARAMETER ANALYSIS

EPPINGHAM

SAMPLE NUMBER	103	114	124	135	146	157		Avg.
pH	6.6	6.7	7.2	7.2	7.4	7.2		7.1
T (^{o}C)	19.2	18.4	17.2	16.3	15.8	15.0		17.0
Ammonia	14	17	17	18	18	12		16
Oil and Grease	25	35	40	35	30	90		42
TSS	40	80	80	140	150	110		102
TOC	54	66	74	94	140	105		90
COD	125	180	155	280	190	235		195
BOD	55	85	100	115	150	190		116

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
ORGANICS

AVOCADO

SAMPLE NUMBER	104	115	125	136	147	158		Avg.
110. 1,1-Dichloroethylene	-	-	-	-	-	-		-
111. 1,1-Dichloroethane	-	-	-	-	-	-		-
112. Trans-1,2-dichloroethylene	-	-	-	-	-	-		-
113. Chloroform	2	4	3	4	4	3		3.4
114. 1,2-Dichloroethane	-	-	-	-	-	-		-
115. 1,1,1-Trichloroethane	-	-	2	-	1	-		0.6
116. Carbon tetrachloride	-	-	-	-	-	-		-
117. Bromodichloromethane	-	-	-	-	-	-		-
118. 1,2-Dichloropropane	-	-	-	-	-	-		-
119. Trans-1,3-dichloropropylene	-	-	-	-	-	-		-
120. Trichloroethylene	-	-	-	1	-	7		1.6
121. Benzene	-	-	-	-	1	-		0.2
123. Dibromochloromethane	-	-	-	-	-	-		-
125. Bromoform	-	-	-	-	-	-		-
127. 1,1,2,2-Tetrachloroethylene	10	16	11	17	6	27		15.0
128. Toluene	5	18	3	6	3	3		5.4
129. Chlorobenzene	-	-	-	-	-	-		-
130. Ethyl benzene	-	-	-	-	-	-		-
201. 2-Chlorophenol	-	-	-	-	-	-		-
203. Phenol	11	11	14	13	11	28		15.4
204. 2,4-Dimethylphenol	-	-	-	-	-	11		2.1
205. 2,4-Dichlorophenol	-	-	-	-	-	-		-
206. 2,4,6-Trichlorophenol	-	-	-	-	-	-		-
301. Dichlorobenzenes	30	-	-	49	-	-		12.8
315. Naphthalene	-	-	-	-	-	-		-
326. Diethyl phthalate	10	25	11	11	-	14		11.3
331. Anthracene/Phenanthrene	-	-	-	-	-	-		-
333. Di-n-butyl phthalate	-	26	14	-	-	91		23.8
335. Pyrene	-	-	-	-	-	-		-
337. Butyl benzyl phthalate	13	15	14	14	-	14		11.9
338. Bis (2-ethylhexyl) phthalate	-	-	-	-	-	-		-
406. Aldrin	-	3	-	2	-	-		0.8

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
METALS, CYANIDES, AND PHENOLS

AVOCADO

SAMPLE NUMBER	104	115	125	136	147	158		Avg.
501. Antimony	7	18	11	23	5	9		12.4
502. Arsenic	–	–	–	–	–	–		–
503. Beryllium	–	–	–	–	–	–		–
504. Cadmium	–	–	–	5	–	–		1.0
505. Chromium	8	6	6	10	10	6		7.6
506. Copper	38	36	34	37	33	36		35.5
507. Lead	51	56	54	59	53	53		54.6
508. Manganese	200	230	240	200	230	210		220
509. Mercury	–	3	–	5	5	–		2.1
510. Nickel	11	6	8	8	9	7		8.1
511. Selenium	15	15	13	14	20	8		13.7
512. Silver	–	–	–	–	50	20		11.4
513. Thallium	–	–	–	–	–	–		–
514. Zinc	110	93	78	120	120	76		97.2
601. Total Cyanides	–	–	–	–	–	–		–
602. Total Phenols	10	28	48	39	53	48		40.9

CLASSICAL WASTEWATER PARAMETER ANALYSIS

AVOCADO

SAMPLE NUMBER	104	115	125	136	147	158		Avg.
pH	6.3	6.8	7.2	7.1	7.4	7.1		7.0
T (^{o}C)	19.0	18.6	17.7	16.5	16.0	14.8		17.1
Ammonia	24	21	20	22	23	19		21.2
Oil and Grease	45	80	45	30	30	100		54
TSS	160	90	170	60	190	130		134
TOC	96	108	140	80	125	175		125
COD	370	400	305	175	270	315		293
BOD	155	135	230	100	225	220		184

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
ORGANICS

BRIGHTWELL St. Louis Samples

SAMPLE NUMBER	106	117	127	138	149	160		Avg.
110. 1,1-Dichloroethylene	–	–	–	–	–	–		–
111. 1,1-Dichloroethane	–	–	–	–	–	–		–
112. Trans-1,2-dichloroethylene	–	–	–	–	–	–		–
113. Chloroform	4	4	5	–	3	3		3.3
114. 1,2-Dichloroethane	–	–	–	5	–	–		0.7
115. 1,1,1-Trichloroethane	1	1	3	–	1	1		1.2
116. Carbon tetrachloride	–	–	–	–	–	–		–
117. Bromodichloromethane	2	–	–	–	–	–		0.3
118. 1,2-Dichloropropane	–	–	–	–	–	–		–
119. Trans-1,3-dichloropropylene	–	–	–	–	–	–		–
120. Trichloroethylene	2	–	–	–	–	–		0.3
121. Benzene	2	2	3	1	1	–		1.5
123. Dibromochloromethane	2	–	–	–	–	–		0.3
125. Bromoform	–	–	–	–	–	–		–
127. 1,1,2,2-Tetrachloroethylene	26	19	12	14	14	11		15.9
128. Toluene	5	6	38	12	8	1		11.9
129. Chlorobenzene	1	–	1	–	–	–		0.3
130. Ethyl benzene	–	1	15	4	–	–		3.4
201. 2-Chlorophenol	–	–	–	–	–	–		–
203. Phenol	–	12	–	15	–	13		6.2
204. 2,4-Dimethylphenol	–	–	–	–	–	–		–
205. 2,4-Dichlorophenol	–	–	–	–	–	–		–
206. 2,4,6-Trichlorophenol	–	–	–	–	–	–		–
301. Dichlorobenzenes	32	35	–	31	–	31		20.4
315. Naphthalene	–	14	94	–	–	–		19.1
326. Diethyl phthalate	–	–	–	11	–	11		3.4
331. Anthracene/Phenanthrene	–	–	107	–	–	–		17.8
333. Di-n-butyl phthalate	–	12	–	14	17	–		7.1
335. Pyrene	–	–	9	–	–	–		1.5
337. Butyl benzyl phthalate	15	23	48	15	26	17		24.7
338. Bis (2-ethylhexyl) phthalate	240	14	34	–	–	–		46.4
406. Aldrin	–	–	–	–	–	–		–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
METALS, CYANIDES, AND PHENOLS

BRIGHTWELL

SAMPLE NUMBER	106	117	127	138	149	160		Avg.
501. Antimony	-	-	-	-	-	-		-
502. Arsenic	-	-	-	-	-	-		-
503. Beryllium	-	-	-	-	-	-		-
504. Cadmium	-	4	31	-	-	-		6.2
505. Chromium	6	11	9	8	10	17		10.3
506. Copper	84	200	75	49	350	33		139.1
507. Lead	490	2200	420	210	1200	89		792
508. Manganese	100	110	120	90	100	120		107.3
509. Mercury	-	3	-	3	-	-		0.9
510. Nickel	8	11	12	8	10	11		10.1
511. Selenium	10	10	9	9	8	7		8.8
512. Silver	-	-	-	-	-	4		0.7
513. Thallium	-	-	-	-	-	-		-
514. Zinc	140	440	200	230	5400	100		1209
601. Total Cyanides	-	-	11	-	-	-		2.0
602. Total Phenols	31	24	47	51	41	30		37.1

CLASSICAL WASTEWATER PARAMETER ANALYSIS

BRIGHTWELL

SAMPLE NUMBER	106	117	127	138	149	160		Avg.
pH	6.6	6.7	7.0	7.6	7.3	7.2		7.1
T (^{o}C)	18.5	18.5	17.2	15.7	14.5	16.5		16.8
Ammonia	16	19	19	17	14	15		17
Oil and Grease	35	85	2500	30	60	40		490
TSS	80	180	210	120	170	110		148
TOC	70	104	160	92	105	120		110
COD	205	330	550	285	280	190		310
BOD	90	115	325	110	155	140		160

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
ORGANICS

CROSS KEYS St. Louis Samples

SAMPLE NUMBER		105	116	126	137	148	159		Avg.
110.	1,1-Dichloroethylene	–	–	–	–	8	–		1.3
111.	1,1-Dichloroethane	–	–	–	–	–	–		–
112.	Trans-1,2-dichloroethylene	2	2	3	3	3	3		2.7
113.	Chloroform	5	6	7	8	7	5		6.3
114.	1,2-Dichloroethane	–	–	–	–	–	–		–
115.	1,1,1-Trichloroethane	–	2	1	1	–	1		0.8
116.	Carbon tetrachloride	–	–	–	–	–	–		–
117.	Bromodichloromethane	2	2	2	4	3	2		2.5
118.	1,2-Dichloropropane	–	–	–	–	–	–		–
119.	Trans-1,3-dichloropropylene	–	–	–	–	–	–		–
120.	Trichloroethylene	–	–	–	–	–	–		–
121.	Benzene	1	1	2	1	1	–		1
123.	Dibromochloromethane	2	1	1	4	2	2		2
125.	Bromoform	–	–	–	–	–	–		–
127.	1,1,2,2-Tetrachloroethylene	19	69	21	100	38	28		45.3
128.	Toluene	6	6	5	7	6	6		6
129.	Chlorobenzene	–	–	–	–	–	–		–
130.	Ethyl benzene	–	–	–	–	1	–		0.2
201.	2-Chlorophenol	–	–	–	–	–	–		–
203.	Phenol	10	–	16	10	–	–		6.1
204.	2,4-Dimethylphenol	–	–	–	–	–	–		–
205.	2,4-Dichlorophenol	–	–	–	–	–	–		–
206.	2,4,6-Trichlorophenol	–	–	–	–	–	–		–
301.	Dichlorobenzenes	31	32	34	30	30	–		25.9
315.	Naphthalene	–	–	–	–	–	–		–
326.	Diethyl phthalate	–	18	30	14	–	11		12.1
331.	Anthracene/Phenanthrene	–	–	–	–	–	–		–
333.	Di-n-butyl phthalate	–	15	14	–	–	–		4.7
335.	Pyrene	–	–	–	–	–	–		–
337.	Butyl benzyl phthalate	24	13	16	13	13	18		16.3
338.	Bis (2-ethylhexyl) phthalate	14	–	12	–	–	–		4.4
406.	Aldrin	–	–	–	–	–	–		–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
METALS, CYANIDES, AND PHENOLS

CROSS KEYS

SAMPLE NUMBER		105	116	126	137	148	159		Avg.
501.	Antimony	–	–	–	–	–	–		–
502.	Arsenic	–	–	–	–	–	–		–
503.	Beryllium	–	–	–	–	–	–		–
504.	Cadmium	–	–	–	–	–	–		–
505.	Chromium	8	6	6	4	9	8		6.8
506.	Copper	40	37	34	40	51	48		41.7
507.	Lead	110	69	64	61	170	53		87.1
508.	Manganese	98	84	92	74	120	82		91.5
509.	Mercury	–	–	–	4	–	–		0.7
510.	Nickel	11	6	5	5	13	7		7.8
511.	Selenium	17	18	17	18	23	16		18.1
512.	Silver	–	7	–	–	–	–		1.1
513.	Thallium	–	–	–	–	–	–		–
514.	Zinc	120	76	66	74	270	91		115
601.	Total Cyanides	–	–	–	–	–	–		–
602.	Total Phenols	–	21	62	37	47	27		32.0

CLASSICAL WASTEWATER PARAMETER ANALYSIS

CROSS KEYS

SAMPLE NUMBER	105	116	126	137	148	159		Avg.
pH	6.5	6.8	7.0	7.1	7.4	7.1		7.0
T (^{o}C)	19.7	20.0	18.7	17.0	16.1	16.3		18.0
Ammonia	7.5	9.3	10.0	9.9	7.9	7.7		8.7
Oil and Grease	30	100	20	60	40	45		49
TSS	140	80	90	70	70	220		114
TOC	96	100	80	82	76	110		91
COD	360	370	185	170	125	185		233
BOD	165	120	100	150	140	180		143

NORTHWEST

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
ORGANICS

St. Louis Samples

SAMPLE NUMBER	110	121	132	142	153	164		Avg.
110. 1,1-Dichloroethylene	–	–	5	–	–	–		0.8
111. 1,1-Dichloroethane	–	–	3	–	–	–		0.5
112. Trans-1,2-dichloroethylene	–	–	–	–	–	–		–
113. Chloroform	6	7	6	5	6	5		5.8
114. 1,2-Dichloroethane	–	–	–	–	–	–		–
115. 1,1,1-Trichloroethane	12	10	26	5	9	2		10.3
116. Carbon tetrachloride	–	–	–	–	–	–		–
117. Bromodichloromethane	3	1	2	2	2	2		2
118. 1,2-Dichloropropane	–	–	–	–	–	–		–
119. Trans-1,3-dichloropropylene	1	–	–	–	–	–		0.2
120. Trichloroethylene	–	–	–	–	–	–		–
121. Benzene	5	5	6	5	4	3		4.6
123. Dibromochloromethane	2	1	1	2	2	1		1.5
125. Bromoform	–	–	–	–	–	–		–
127. 1,1,2,2-Tetrachloroethylene	10	7	6	17	59	23		21
128. Toluene	19	29	44	25	19	13		24
129. Chlorobenzene	1	–	–	–	–	1		0.4
130. Ethyl benzene	3	4	5	4	3	3		3.7
201. 2-Chlorophenol	–	–	–	–	–	–		–
203. Phenol	–	–	15	12	–	–		4.4
204. 2,4-Dimethylphenol	–	–	–	–	–	–		–
205. 2,4-Dichlorophenol	–	–	–	–	–	–		–
206. 2,4,6-Trichlorophenol	–	–	–	–	–	–		–
301. Dichlorobenzenes	–	42	34	30	34	–		22.7
315. Naphthalene	–	–	13	–	–	13		4.6
326. Diethyl phthalate	17	–	17	–	–	–		5.4
331. Anthracene/Phenanthrene	–	–	–	–	–	–		–
333. Di-n-butyl phthalate	80	–	20	–	–	–		16
335. Pyrene	–	–	–	–	–	–		–
337. Butyl benzyl phthalate	27	14	14	12	–	15		13.7
338. Bis (2-ethylhexyl) phthalate	27	–	–	–	–	–		4.2
406. Aldrin	–	–	–	–	–	–		–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
METALS, CYANIDES, AND PHENOLS

NORTHWEST

SAMPLE NUMBER	110	121	132	142	153	164		Avg.
501. Antimony	-	-	-	-	-	-		-
502. Arsenic	-	-	-	-	-	-		-
503. Beryllium	-	-	-	-	-	-		-
504. Cadmium	-	-	-	-	-	-		-
505. Chromium	100	8	7	NA*	8	9		21.1
506. Copper	37	30	46	28	27	27		32.3
507. Lead	74	120	100	82	71	84		88.7
508. Manganese	260	270	260	270	250	300		270
509. Mercury	3	-	-	-	-	-		0.5
510. Nickel	10	7	7	6	8	7		7.5
511. Selenium	-	-	-	4	-	-		0.7
512. Silver	-	7	-	10	4	-		3.5
513. Thallium	-	-	-	-	-	-		-
514. Zinc	91	80	85	71	66	64		75.7
601. Total Cyanides	-	-	-	-	10	-		1.5
602. Total Phenols	12	42	36	35	42	18		30.5

* NA = Not Analyzed

CLASSICAL WASTEWATER PARAMETER ANALYSIS

NORTHWEST

SAMPLE NUMBER	110	121	132	142	153	164		Avg.
pH	6.8	7.0	7.3	7.2	7.0	6.6		7.0
T (^oC)	16.6	16.7	17.2	17.1	18.5	15.9		17.0
Ammonia	8.6	10	11	11	12	7.2		10
Oil and Grease	30	40	70	20	60	30		41
TSS	80	110	60	100	110	50		84
TOC	74	140	92	135	110	110		111
COD	180	380	160	295	210	100		218
BOD	145	245	120	270	220	130		187

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
ORGANICS

FROST

St. Louis Samples

SAMPLE NUMBER	108	119	130	140	151	162		Avg.
110. 1,1-Dichloroethylene	–	–	–	–	–	–		–
111. 1,1-Dichloroethane	–	–	–	–	–	–		–
112. Trans-1,2-dichloroethylene	–	–	–	–	–	1		0.2
113. Chloroform	7	44	11	8	39	9		19.8
114. 1,2-Dichloroethane	–	–	–	–	–	–		–
115. 1,1,1-Trichloroethane	5	4	23	6	3	7		8.1
116. Carbon tetrachloride	–	2	–	1	–	–		0.5
117. Bromodichloromethane	2	4	2	2	3	1		2.3
118. 1,2-Dichloropropane	–	–	–	–	–	–		–
119. Trans-1,3-dichloropropylene	–	–	–	–	–	–		–
120. Trichloroethylene	7	8	75	38	4	2		22.5
121. Benzene	2	1	2	3	2	2		2
123. Dibromochloromethane	2	2	1	2	2	1		1.7
125. Bromoform	–	–	–	–	–	–		–
127. 1,1,2,2-Tetrachloroethylene	8	11	19	14	32	18		17.1
128. Toluene	5	4	4	14	3	3		5.4
129. Chlorobenzene	–	–	–	–	–	–		–
130. Ethyl benzene	–	–	2	–	–	1		0.5
201. 2-Chlorophenol	–	–	–	–	15	–		2.5
203. Phenol	–	–	11	16	–	17		7.3
204. 2,4-Dimethylphenol	–	–	–	–	–	–		–
205. 2,4-Dichlorophenol	–	–	–	–	15	–		2.5
206. 2,4,6-Trichlorophenol	–	–	–	–	12	–		2
301. Dichlorobenzenes	32	36	35	32	31	–		27.6
315. Naphthalene	12	–	12	33	–	–		9.2
326. Diethyl phthalate	–	–	–	–	–	–		–
331. Anthracene/Phenanthrene	–	–	–	–	–	–		–
333. Di-n-butyl phthalate	13	230	200	36	–	–		81.1
335. Pyrene	–	–	–	–	–	–		–
337. Butyl benzyl phthalate	11	53	26	–	–	14		17.6
338. Bis (2-ethylhexyl) phthalate	–	–	–	–	–	–		–
406. Aldrin	–	–	–	–	–	–		–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
METALS, CYANIDES, AND PHENOLS

FROST

SAMPLE NUMBER	108	119	130	140	151	162		Avg.
501. Antimony	9	9	10	10	8	7		8.8
502. Arsenic	–	–	–	–	–	–		–
503. Beryllium	–	–	–	–	–	–		–
504. Cadmium	–	–	14	31	21	–		10.8
505. Chromium	22	660	36	22	48	17		134
506. Copper	34	220	57	42	34	36		70.5
507. Lead	76	170	86	80	92	71		95.8
508. Manganese	200	180	200	210	220	220		205
509. Mercury	–	–	–	–	–	–		–
510. Nickel	7	19	10	9	9	8		10.3
511. Selenium	7	–	–	12	–	–		3.0
512. Silver	–	6	–	4	7	–		2.8
513. Thallium	–	–	–	2	–	–		0.3
514. Zinc	840	710	900	800	450	220		652
601. Total Cyanides	29	80	20	132	66	18		56.2
602. Total Phenols	26	26	46	33	14	26		28.5

CLASSICAL WASTEWATER PARAMETER ANALYSIS

FROST

SAMPLE NUMBER	108	119	130	140	151	162		Avg.
pH	7.1	7.8	7.3	7.3	9.4	6.7		7.6
T (°C)	15.2	15.8	15.3	16.2	17.0	15.4		15.8
Ammonia	12	7.8	12	14	8.9	10		11
Oil and Grease	40	20	20	20	30	-		22
TSS	60	100	100	50	140	130		97
TOC	56	88	76	74	94	92		80
COD	155	290	180	115	230	180		193
BOD	65	75	90	90	-	100		70

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
ORGANICS

WABASH

St. Louis Samples

SAMPLE NUMBER	107	118	129	139	150	161		Avg.
110. 1,1-Dichloroethylene	–	–	–	–	–	–		–
111. 1,1-Dichloroethane	–	–	–	–	–	–		–
112. Trans-1,2-dichloroethylene	1	–	–	–	–	1		0.3
113. Chloroform	7	6	7	6	5	6		6.1
114. 1,2-Dichloroethane	–	–	–	–	–	–		–
115. 1,1,1-Trichloroethane	2	1	–	1	7	5		2.8
116. Carbon tetrachloride	–	–	–	–	–	–		–
117. Bromodichloromethane	3	2	2	3	–	2		1.9
118. 1,2-Dichloropropane	23	4	–	–	–	–		4.5
119. Trans-1,3-dichloropropylene	–	–	–	–	–	1		0.2
120. Trichloroethylene	–	–	–	–	–	–		–
121. Benzene	3	2	2	3	3	3		2.7
123. Dibromochloromethane	2	2	2	2	2	1		1.8
125. Bromoform	–	–	–	–	–	–		–
127. 1,1,2,2-Tetrachloroethylene	31	7	7	15	7	22		14.6
128. Toluene	6	5	4	18	4	5		6.8
129. Chlorobenzene	–	–	–	–	–	1		0.2
130. Ethyl benzene	–	–	–	–	–	1		0.2
201. 2-Chlorophenol	–	–	–	–	–	–		–
203. Phenol	14	24	21	19	17	44		23.3
204. 2,4-Dimethylphenol	–	–	–	–	–	–		–
205. 2,4-Dichlorophenol	–	–	–	–	–	–		–
206. 2,4,6-Trichlorophenol	–	–	–	–	–	–		–
301. Dichlorobenzenes	33	32	33	34	30	30		31.9
315. Naphthalene	–	–	–	–	–	–		–
326. Diethyl phthalate	–	–	11	–	–	–		1.8
331. Anthracene/Phenanthrene	–	–	–	–	–	–		–
333. Di-n-butyl phthalate	–	14	12	–	11	–		6.4
335. Pyrene	–	–	–	–	–	–		–
337. Butyl benzyl phthalate	12	11	13	10	–	12		9.4
338. Bis (2-ethylhexyl) phthalate	–	–	–	–	–	11		1.9
406. Aldrin	–	–	–	–	–	–		–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
METALS, CYANIDES, AND PHENOLS

WABASH

SAMPLE NUMBER	107	118	129	139	150	161		Avg.
501. Antimony	–	–	–	–	–	–		–
502. Arsenic	–	–	–	–	–	–		–
503. Beryllium	–	–	–	–	–	–		–
504. Cadmium	–	–	–	6	9	4		3.3
505. Chromium	44	24	46	35	29	12		31.3
506. Copper	31	69	100	35	40	36		51.6
507. Lead	66	190	61	64	68	60		84.4
508. Manganese	210	220	200	220	180	180		201
509. Mercury	–	–	–	–	–	–		–
510. Nickel	8	7	8	8	9	13		8.9
511. Selenium	13	13	11	7	14	7		10.9
512. Silver	–	–	–	–	4	–		0.8
513. Thallium	–	–	–	–	2	–		0.4
514. Zinc	1900	1300	1500	2000	880	210		1266
601. Total Cyanides	34	88	38	62	32	56		51.1
602. Total Phenols	20	34	38	51	58	56		43.5

CLASSICAL WASTEWATER PARAMETER ANALYSIS

WABASH

SAMPLE NUMBER	107	118	129	139	150	161		Avg.
pH	6.9	7.2	7.5	7.0	7.8	6.6		7.2
T (^{o}C)	15.5	15.4	15.[illegible]	16.2	16.9	14.8		15.7
Ammonia	10	12	11	15	12	11		12
Oil and Grease	25	25	25	30	40	50		33
TSS	70	70	60	80	110	70		78
TOC	64	88	66	86	86	82		79
COD	225	310	230	135	195	160		209
BOD	50	100	80	115	135	115		101

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
ORGANICS

BROWN

St. Louis Samples

SAMPLE NUMBER		109	120	131	141	152	163		Avg.
110.	1,1-Dichloroethylene	–	–	–	–	–	–		–
111.	1,1-Dichloroethane	–	–	–	–	–	–		–
112.	Trans-1,2-dichloroethylene	–	–	–	–	–	–		–
113.	Chloroform	6	8	8	7	5	5		6.8
114.	1,2-Dichloroethane	–	–	–	–	–	–		–
115.	1,1,1-Trichloroethane	–	–	–	–	–	–		–
116.	Carbon tetrachloride	–	–	–	–	–	–		–
117.	Bromodichloromethane	4	3	4	5	4	3		3.9
118.	1,2-Dichloropropane	–	–	–	–	–	–		–
119.	Trans-1,3-dichloropropylene	–	–	–	–	–	–		–
120.	Trichloroethylene	21	17	16	18	18	29		19.0
121.	Benzene	–	1	1	1	–	–		0.6
123.	Dibromochloromethane	3	2	3	4	3	2		2.9
125.	Bromoform	–	–	–	–	–	–		–
127.	1,1,2,2-Tetrachloroethylene	16	3	2	2	74	5		14
128.	Toluene	5	4	4	9	25	200		30
129.	Chlorobenzene	–	–	–	–	–	–		–
130.	Ethyl benzene	4	2	1	–	2	4		1.9
201.	2-Chlorophenol	–	–	–	–	–	–		–
203.	Phenol	–	–	–	–	–	–		–
204.	2,4-Dimethylphenol	–	–	–	–	–	–		–
205.	2,4-Dichlorophenol	–	–	–	–	–	–		–
206.	2,4,6-Trichlorophenol	–	–	–	–	–	–		–
301.	Dichlorobenzenes	36	33	31	–	–	–		17
315.	Naphthalene	23	13	14	12	–	–		11
326.	Diethyl phthalate	–	–	–	–	–	–		–
331.	Anthracene/Phenanthrene	–	–	–	–	–	–		–
333.	Di-n-butyl phthalate	140	87	280	55	–	–		99
335.	Pyrene	–	–	–	–	–	–		–
337.	Butyl benzyl phthalate	–	–	–	–	–	10		0.9
338.	Bis (2-ethylhexyl) phthalate	–	–	–	–	–	–		–
406.	Aldrin	–	–	–	–	–	–		–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
METALS, CYANIDES, AND PHENOLS

BROWN

SAMPLE NUMBER		109	120	131	141	152	163		Avg.
501.	Antimony	-	-	-	-	-	-		-
502.	Arsenic	5	7	11	5	5	-		6.1
503.	Beryllium	-	-	-	-	-	-		-
504.	Cadmium	-	-	-	-	30	-		4
505.	Chromium	29	33	14	12	12	9		18
506.	Copper	36	37	64	43	31	32		42.0
507.	Lead	54	65	150	60	86	60		78
508.	Manganese	77	63	47	51	71	60		60.7
509.	Mercury	-	-	-	-	-	-		-
510.	Nickel	7	6	4	6	6	6		5.8
511.	Selenium	-	-	-	-	-	4		4
512.	Silver	91	740	230	690	1100	600		567
513.	Thallium	-	-	-	-	-	-		-
514.	Zinc	140	91	140	150	110	66		122

601.	Total Cyanides	-	-	10	-	-	-		1.9

602.	Total Phenols	24	44	30	10	36	23		27.8

CLASSICAL WASTEWATER PARAMETER ANALYSIS

BROWN

SAMPLE NUMBER	109	120	131	141	152	163		Avg.
pH	7.3	7.6	8.0	7.4	8.4	6.9		7.6
T (°C)	14.9	14.4	15.4	15.6	16.7	12.7		15.0
Ammonia	20	26	20	17	23	24		21
Oil and Grease	-	15	10	-	10	-		6
TSS	50	60	40	70	20	20		48
TOC	34	52	42	42	28	20		38
COD	150	190	135	115	160	130		144
BOD	40	40	60	65	30	30		47

TAP WATER

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
ORGANICS

St. Louis Samples

SAMPLE NUMBER	111	165						Avg.
110. 1,1-Dichloroethylene	-	-						-
111. 1,1-Dichloroethane	-	-						-
112. Trans-1,2-dichloroethylene	-	-						-
113. Chloroform	20	22						21
114. 1,2-Dichloroethane	-	-						-
115. 1,1,1-Trichloroethane	-	-						-
116. Carbon tetrachloride	-	-						-
117. Bromodichloromethane	12	13						12.5
118. 1,2-Dichloropropane	-	-						-
119. Trans-1,3-dichloropropylene	-	-						-
120. Trichloroethylene	-	-						-
121. Benzene	-	-						-
123. Dibromochloromethane	7	9						8
125. Bromoform	-	3						1.5
127. 1,1,2,2-Tetrachloroethylene	2	1						1.5
128. Toluene	2	-						1
129. Chlorobenzene	-	-						-
130. Ethyl benzene	-	-						-
201. 2-Chlorophenol	-	-						-
203. Phenol	-	-						-
204. 2,4-Dimethylphenol	-	-						-
205. 2,4-Dichlorophenol	-	-						-
206. 2,4,6-Trichlorophenol	-	-						-
301. Dichlorobenzenes	-	-						-
315. Naphthalene	-	-						-
326. Diethyl phthalate	-	-						-
331. Anthracene/Phenanthrene	-	-						-
333. Di-n-butyl phthalate	-	-						-
335. Pyrene	-	-						-
337. Butyl benzyl phthalate	-	-						-
338. Bis (2-ethylhexyl) phthalate	-	-						-
406. Aldrin	-	-						-

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
METALS, CYANIDES, AND PHENOLS

TAP WATER

SAMPLE NUMBER		111	165						Avg.
501.	Antimony	12	12						12
502.	Arsenic	–	–						–
503.	Beryllium	–	–						–
504.	Cadmium	–	–						–
505.	Chromium	–	–						–
506.	Copper	7	6						6.5
507.	Lead	30	27						28.5
508.	Manganese	–	–						–
509.	Mercury	–	–						–
510.	Nickel	–	–						–
511.	Selenium	8	8						8
512.	Silver	–	–						–
513.	Thallium	–	–						–
514.	Zinc	29	–						14.5
601.	Total Cyanides	–	–						–
602.	Total Phenols	–	–						–

CLASSICAL WASTEWATER PARAMETER ANALYSIS

TAP WATER

SAMPLE NUMBER	111	165						Avg.
pH	8.6	7.7						8.2
T (^oC)	20.7	20.0						20.4
Ammonia	0.50	0.40						0.5
Oil and Grease	-	-						-
TSS	-	-						-
TOC	8	8						8
COD	-	-						-
BOD	-	-						-

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
ORGANICS

POTW INFLUENT

SAMPLE NUMBER	101	112	122	133	144	155		Avg.
110. 1,1-Dichloroethylene	5	–	–	–	–	–		0.8
111. 1,1-Dichloroethane	2	–	–	–	–	–		0.3
112. Trans-1,2-dichloroethylene	1	–	–	–	–	2		0.5
113. Chloroform	6	9	6	4	7	5		6.2
114. 1,2-Dichloroethane	–	–	–	–	–	–		–
115. 1,1,1-Trichloroethane	19	12	11	7	4	2		9.2
116. Carbon tetrachloride	–	–	–	–	–	–		–
117. Bromodichloromethane	–	2	–	–	2	–		0.7
118. 1,2-Dichloropropane	–	–	–	–	–	–		–
119. Trans-1,3-dichloropropylene	–	–	–	–	–	–		–
120. Trichloroethylene	25	23	31	47	37	9		28.7
121. Benzene	6	8	7	7	8	6		7
123. Dibromochloromethane	1	2	–	1	2	–		1
125. Bromoform	–	–	–	–	–	–		–
127. 1,1,2,2-Tetrachloroethylene	40	41	51	70	32	36		45
128. Toluene	41	65	83	73	57	43		60.3
129. Chlorobenzene	–	–	–	–	–	1		0.2
130. Ethyl benzene	12	20	17	17	16	12		15.7
201. 2-Chlorophenol	–	–	–	–	–	–		–
203. Phenol	–	19	12	17	16	–		10.7
204. 2,4-Dimethylphenol	–	–	–	–	–	–		–
205. 2,4-Dichlorophenol	–	–	–	–	–	–		–
206. 2,4,6-Trichlorophenol	–	–	–	–	–	–		–
301. Dichlorobenzenes	31	34	31	–	30	30		26
315. Naphthalene	10	23	13	13	–	–		9.8
326. Diethyl phthalate	–	–	13	12	–	17		7
331. Anthracene/Phenanthrene	–	–	–	–	–	–		–
333. Di-n-butyl phthalate	12	26	21	12	13	11		15.8
335. Pyrene	–	–	–	–	–	–		–
337. Butyl benzyl phthalate	14	13	16	11	14	–		11.3
338. Bis (2-ethylhexyl) phthalate	–	–	13	–	13	–		4.3
406. Aldrin	–	–	–	–	–	–		–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
METALS, CYANIDES, AND PHENOLS

POTW INFLUENT

SAMPLE NUMBER	101	112	122	133	144	155		Avg.
501. Antimony	7	51	200	32	11	14		52.5
502. Arsenic	–	–	–	–	–	–		–
503. Beryllium	–	–	–	–	–	–		–
504. Cadmium	–	2	2	8	6	–		3
505. Chromium	125	150	180	140	160	58		136
506. Copper	38	53	43	59	48	39		46.7
507. Lead	220	220	250	310	160	100		210
508. Manganese	200	200	200	200	210	200		202
509. Mercury	–	3	–	–	–	–		0.5
510. Nickel	52	60	65	57	29	11		45.7
511. Selenium	21	–	–	–	4	–		4.2
512. Silver	18	17	16	19	12	14		16
513. Thallium	–	–	–	–	–	–		–
514. Zinc	290	330	420	310	250	140		290
601. Total Cyanides	12	21	22	22	–	10		14.5
602. Total Phenols	58	55	80	75	63	34		60.8

CLASSICAL WASTEWATER PARAMETER ANALYSIS

POTW INFLUENT

SAMPLE NUMBER	101	112	122	133	144	155		Avg.
pH	7.0	7.3	7.0	7.0	7.0	6.8		7.0
T (°C)	18.6	18.6	18.9	18.6	18.6	18.5		18.6
Ammonia	14	16	17	21	18	16		17
Oil and Grease	50	20	35	40	20	20		31
TSS	100	100	160	140	130	120		125
TOC	82	100	94	105	98	105		97
COD	200	410	430	285	255	255		306
BOD	125	140	165	170	150	180		155

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)
ORGANICS

POTW EFFLUENT

SAMPLE NUMBER		102	113	123	134	145	156		Avg.
110.	1,1-Dichloroethylene	–	–	–	–	–	–		–
111.	1,1-Dichloroethane	–	–	–	–	–	–		–
112.	Trans-1,2-dichloroethylene	–	–	–	–	–	–		–
113.	Chloroform	3	2	–	3	3	3		2.3
114.	1,2-Dichloroethane	–	–	–	–	–	–		–
115.	1,1,1-Trichloroethane	3	1	–	2	1	–		1.2
116.	Carbon tetrachloride	–	–	–	–	–	–		–
117.	Bromodichloromethane	–	–	–	–	–	–		–
118.	1,2-Dichloropropane	–	–	–	–	–	–		–
119.	Trans-1,3-dichloropropylene	–	–	–	–	–	–		–
120.	Trichloroethylene	6	6	–	8	8	2		5
121.	Benzene	–	–	22	1	–	–		3.8
123.	Dibromochloromethane	–	1	–	–	1	–		0.3
125.	Bromoform	–	–	–	–	–	–		–
127.	1,1,2,2-Tetrachloroethylene	14	10	13	14	7	–		9.7
128.	Toluene	1	2	4	–	–	2		1.5
129.	Chlorobenzene	–	–	–	–	–	–		–
130.	Ethyl benzene	–	–	–	6	–	–		1
201.	2-Chlorophenol	–	–	–	–	–	–		–
203.	Phenol	–	–	–	–	–	–		–
204.	2,4-Dimethylphenol	–	–	–	–	–	–		–
205.	2,4-Dichlorophenol	–	–	–	–	–	–		–
206.	2,4,6-Trichlorophenol	–	–	–	–	–	–		–
301.	Dichlorobenzenes	–	–	–	–	–	–		–
315.	Naphthalene	–	–	–	–	–	–		–
326.	Diethyl phthalate	–	–	–	–	–	–		–
331.	Anthracene/Phenanthrene	–	–	–	13	–	–		2.2
333.	Di-n-butyl phthalate	–	–	13	–	–	–		2.2
335.	Pyrene	–	–	–	–	–	–		–
337.	Butyl benzyl phthalate	–	–	–	–	–	–		–
338.	Bis (2-ethylhexyl) phthalate	–	–	–	–	–	–		–
406.	Aldrin	–	–	–	–	–	–		–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)
METALS, CYANIDES, AND PHENOLS

POTW EFFLUENT

SAMPLE NUMBER		102	113	123	134	145	156		Avg.
501.	Antimony	17	30	23	19	15	35		23.2
502.	Arsenic	-	-	-	-	-	-		-
503.	Beryllium	-	-	-	-	-	-		-
504.	Cadmium	-	5	-	-	-	-		0.8
505.	Chromium	58	58	61	70	76	41		60.7
506.	Copper	10	10	21	18	7	15		13.5
507.	Lead	64	64	60	59	58	56		60.2
508.	Manganese	180	170	160	160	150	42		144
509.	Mercury	-	-	-	-	-	-		-
510.	Nickel	33	35	42	42	31	15		33
511.	Selenium	9	-	7	8	6	6		6
512.	Silver	5	7	5	33	18	7		12.5
513.	Thallium	-	-	-	-	-	-		-
514.	Zinc	86	120	110	95	97	67		95.8
601.	Total Cyanides	-	-	-	-	-	-		-
602.	Total Phenols	-	-	20	11	11	12		9.0

CLASSICAL WASTEWATER PARAMETER ANALYSIS

POTW EFFLUENT

SAMPLE NUMBER	102	113	123	134	145	156		Avg.
pH	7.0	7.1	6.9	6.9	7.0	6.9		7.0
T (°C)	17.4	16.9	17.3	18.0	17.6	17.0		17.4
Ammonia	15	15	14	16	17	16		16
Oil and Grease	-	-	5	-	-	-		1
TSS	25	20	10	15	20	20		18
TOC	23	44	21	28	19	22		26
COD	45	80	50	75	80	80		68
BOD	20	20	15	15	15	25		18

APPENDIX E

ANALYTICAL DATA BY CHEMICAL

This appendix contains the analytical data for all chemicals that were detected above the reporting limits. The data are tabulated by chemical and include measured concentrations, source identification, average concentrations, and fractions of samples in which each pollutant was observed.

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106 METHYLENE CHLORIDE
                                                                          AVERAGE
SITES                                                                      WHEN              FRACTION
                  TUES     WED    THURS      FRI      SAT      SUN      PRESENT  AVERAGE   PRESENT
S EPPINGHAM          7       2        1       12        0        0        5.5      3.7       .67
O AVCCADO            0     700        0      300        0       83      361.0    180.5       .50
U CROSS KEYS         0       0        0        4      300        7      103.7     51.8       .50
R BRIGHTWELL        19       0        0        4        0        9       10.7      5.3       .50
C WABASH            52       0        0        0        0       93       72.5     24.2       .33
E FROST             67      25        0        0        0       32       41.3     20.7       .50
S BROWN            600     500      100      150       37     2000      564.5    564.5      1.00
- NORTHWEST          4    2000        0        0        0       70      691.3    345.7       .50
  TAP WATER                  7                                  15       11.0     11.0      1.00
  POTW INFL         13      64       16        4        0      110       41.4     34.5       .83
  POTW EFFL        400       0        5        0        0     5000     1801.7    900.8       .50

110 1.1-DICHLOROETHYLENE
                                                                          AVERAGE
SITES                                                                      WHEN              FRACTION
                  TUES     WED    THURS      FRI      SAT      SUN      PRESENT  AVERAGE   PRESENT
S EPPINGHAM          0       0        0        0        0        0         .0       .0       .00
O AVCCADO            0       0        0        0        0        0         .0       .0       .00
U CROSS KEYS         0       0        0        0        8        0        8.0      1.3       .17
R BRIGHTWELL         0       0        0        0        0        0         .0       .0       .00
C WABASH             0       0        0        0        0        0         .0       .0       .00
E FROST              0       0        0        0        0        0         .0       .0       .00
S BROWN              0       0        0        0        0        0         .0       .0       .00
- NORTHWEST          0       0        5        0        0        0        5.0       .8       .17
  TAP WATER                  0                                   0         .0       .0       .00
  POTW INFL          5       0        0        0        0        0        5.0       .8       .17
  POTW EFFL          0                0        0        0        0         .0       .0       .00

111 1.1-DICHLOROETHANE
                                                                          AVERAGE
SITES                                                                      WHEN              FRACTION
                  TUES     WED    THURS      FRI      SAT      SUN      PRESENT  AVERAGE   PRESENT
S EPPINGHAM          0       0        0        0        0        0         .0       .0       .00
O AVCCADO            0       0        0        0        0        0         .0       .0       .00
U CROSS KEYS         0       0        0        0        0        0         .0       .0       .00
R BRIGHTWELL         0       0        0        0        0        0         .0       .0       .00
C WABASH             0       0        0        0        0        0         .0       .0       .00
E FROST              0       0        0        0        0        0         .0       .0       .00
S BROWN              0       0        0        0        0        0         .0       .0       .00
- NORTHWEST          0       0        3        0        0        0        3.0       .5       .17
  TAP WATER                  0                                   0         .0       .0       .00
  POTW INFL          2       0        0        0        0        0        2.0       .3       .17
  POTW EFFL          0       0        0        0        0        0         .0       .0       .00
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112 TRANS-1,2-DICHLORCETHYLENE
                                                                        AVERAGE
SITES                                                                     WHEN               FRACTION
                  TUES     WED     THURS     FRI      SAT      SUN      PRESENT   AVERAGE    PRESENT
S EPPINGHAM          0       0         0       0        0        0           .0        .0        .00
O AVCCADO            0       0         0       0        0        0           .0        .0        .00
U CROSS KEYS         2       2         3       3        3        3          2.7       2.7       1.00
R BRIGHTWELL         0       0         0       0        0        0           .0        .0        .00
C WABASH             1       0         0       0        0        1          1.0        .3        .33
E FROST              0       0         0       0        0        1          1.0        .2        .17
S BROWN              0       0         0       0        0        0           .0        .0        .00
- NURTHWEST          0       0         0       0        0        0           .0        .0        .00
  TAP WATER                  0                                   0           .0        .0        .00
  POTW INFL          1       0         0       0        0        2          1.5        .5        .33
  POTW EFFL          0       0         0       0        0        0           .0        .0        .00

113 CHLCROFCRM
                                                                        AVERAGE
SITES                                                                     WHEN               FRACTIUN
                  TUES     WED     THURS     FRI      SAT      SUN      PRESENT   AVERAGE    PRESENT
S EPPINGHAM          2       3         3       4        3        2          2.8       2.8       1.00
O AVOCADO            2       4         3       4        4        3          3.3       3.3       1.00
U CROSS KEYS         5       6         7       8        7        5          6.3       6.3       1.00
R BRIGHTWELL         4       4         5       0        3        3          3.8       3.2        .83
C WABASH             7       6         7       6        5        6          6.2       6.2       1.00
E FROST              7      44        11       8       39        9         19.7      19.7       1.00
S BROWN              6       8         8       7        5        5          6.5       6.5       1.00
- NORTHWEST          6       7         6       5        6        5          5.8       5.8       1.00
  TAP WATER                 20                                  22         21.0      21.0       1.00
  POTW INFL          6       9         6       4        7        5          6.2       6.2       1.00
  POTW EFFL          3       2         0       3        3        3          2.8       2.3        .83

114 1,2-DICHLUROETHANE
                                                                        AVERAGE
SITES                                                                     WHEN               FRACTION
                  TUES     WED     THURS     FRI      SAT      SUN      PRESENT   AVERAGE    PRESENT
S EPPINGHAM          0       0         0       0        0        0           .0        .0        .00
O AVCCADO            0       0         0       0        0        0           .0        .0        .00
U CROSS KEYS         0       0         0       0        0        0           .0        .0        .00
R BRIGHTWELL         0       0         0       5        0        0          5.0        .8        .17
C WABASH             0       0         0       0        0        0           .0        .0        .00
E FROST              0       0         0       0        0        0           .0        .0        .00
S BRCWN              0       0         0       0        0        0           .0        .0        .00
- NORTHWEST          0       0         0       0        0        0           .0        .0        .00
  TAP WATER                  0                                   0           .0        .0        .00
  POTW INFL          0       0         0       0        0        0           .0        .0        .00
  POTW EFFL          0       0         0       0        0        0           .0        .0        .00
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115 1.1.1-TRICHLOROETHANE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	26	0	0	0	26.0	4.3	.17
O	AVCCADO	0	0	2	0	1	0	1.5	.5	.33
U	CROSS KEYS	0	2	1	1	0	1	1.3	.8	.67
R	BRIGHTWELL	1	1	3	0	1	1	1.4	1.2	.83
C	WABASH	2	1	0	1	7	5	3.2	2.7	.83
E	FROST	5	4	23	6	3	7	8.0	8.0	1.00
S	BROWN	0	0	0	0	0	0	.0	.0	.00
-	NORTHWEST	12	10	26	5	9	2	10.7	10.7	1.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	19	12	11	7	4	2	9.2	9.2	1.00
	POTW EFFL	3	1	0	2	1	0	1.8	1.2	.67

116 CARBON TETRACHLORIDE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVCCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	0	0	0	0	0	.0	.0	.00
C	WABASH	0	0	0	0	0	0	.0	.0	.00
E	FROST	0	2	0	1	0	0	1.5	.5	.33
S	BROWN	0	0	0	0	0	0	.0	.0	.00
-	NORTHWEST	0	0	0	0	0	0	.0	.0	.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	0	0	0	0	0	.0	.0	.00
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

117 BROMODICHLOROMETHANE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVCCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	2	2	2	4	3	2	2.5	2.5	1.00
R	BRIGHTWELL	2	0	0	0	0	0	2.0	.3	.17
C	WABASH	3	2	2	3	0	2	2.4	2.0	.83
E	FROST	2	4	2	2	3	1	2.3	2.3	1.00
S	BROWN	4	3	4	5	4	3	3.8	3.8	1.00
-	NORTHWEST	3	1	2	2	2	2	2.0	2.0	1.00
	TAP WATER		12				13	12.5	12.5	1.00
	POTW INFL	0	2	0	0	2	0	2.0	.7	.33
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

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118 1.2-DICHLOROPROPANE
                                                                         AVERAGE
SITES                                                                     WHEN              FRACTION
                       TUES      WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE   PRESENT
S EPPINGHAM               0        0        0        0        0        0       .0       .0       .00
O AVCCADO                 0        0        0        0        0        0       .0       .0       .00
U CROSS KEYS              0        0        0        0        0        0       .0       .0       .00
R BRIGHTWELL              0        0        0        0        0        0       .0       .0       .00
C WABASH                 23        4        0        0        0        0     13.5      4.5       .33
E FROST                   0        0        0        0        0        0       .0       .0       .00
S BROWN                   0        0        0        0        0        0       .0       .0       .00
- NORTHWEST               0        0        0        0        0        0       .0       .0       .00
  TAP WATER                        0                                   0       .0       .0       .00
  POTW INFL               0        0        0        0        0        0       .0       .0       .00
  POTW EFFL               0        0        0        0        0        0       .0       .0       .00

119 TRANS-1.3-DICHLORCPROPYLEN
                                                                         AVERAGE
SITES                                                                     WHEN              FRACTION
                       TUES      WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE   PRESENT
S EPPINGHAM               0        0        0        0        0        0       .0       .0       .00
O AVCCADO                 0        0        0        0        0        0       .0       .0       .00
U CRCSS KEYS              0        0        0        0        0        0       .0       .0       .00
R BRIGHTWELL              0        0        0        0        0        0       .0       .0       .00
C WABASH                  0        0        0        0        0        1      1.0       .2       .17
E FROST                   0        0        0        0        0        0       .0       .0       .00
S BROWN                   0        0        0        0        0        0       .0       .0       .00
- NORTHWEST               1        0        0        0        0        0      1.0       .2       .17
  TAP WATER                        0                                   0       .0       .0       .00
  POTW INFL               0        0        0        0        0        0       .0       .0       .00
  PCTW EFFL               0        0        0        0        0        0       .0       .0       .00

120 TRICHLOROETHYLENE
                                                                         AVERAGE
SITES                                                                     WHEN              FRACTION
                       TUES      WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE   PRESENT
S EPPINGHAM               0        0        0        0        0        0       .0       .0       .00
O AVCCADO                 0        0        0        1        0        7      4.0      1.3       .33
U CROSS KEYS              0        0        0        0        0        0       .0       .0       .00
R BRIGHTWELL              2        0        0        0        0        0      2.0       .3       .17
C WABASH                  0        0        0        0        0        0       .0       .0       .00
E FROST                   7        8       75       38        4        2     22.3     22.3      1.00
S BROWN                  21       17       16       18       18       29     19.8     19.8      1.00
- NORTHWEST               0        0        0        0        0        0       .0       .0       .00
  TAP WATER                        0                                   0       .0       .0       .00
  POTW INFL              25       23       31       47       37        9     28.7     26.7      1.00
  POTW EFFL               6        6        0        8        8        2      6.0      5.0       .83
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121 BENZENE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	2	1	1	0	1.3	.7	.50
O	AVCCADO	0	0	0	0	1	0	1.0	.2	.17
U	CROSS KEYS	1	1	2	1	1	0	1.2	1.0	.83
R	BRIGHTWELL	2	2	3	1	1	0	1.8	1.5	.83
C	WABASH	3	2	2	3	3	3	2.7	2.7	1.00
E	FROST	2	1	2	3	2	2	2.0	2.0	1.00
S	BROWN	0	1	1	1	0	0	1.0	.5	.50
–	NORTHWEST	5	5	6	5	4	3	4.7	4.7	1.00
	TAP WATER		0				0	.0	.0	.00
	POT. INFL	6	8	7	7	8	6	7.0	7.0	1.00
	POT. EFFL	0	0	22	1	0	0	11.5	3.8	.33

123 DIBROMOCHLOROMETHANE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVCCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	2	1	1	4	2	2	2.0	2.0	1.00
R	BRIGHTWELL	2	0	0	0	0	0	2.0	.3	.17
C	WABASH	2	2	2	2	2	1	1.8	1.8	1.00
E	FROST	2	2	1	2	2	1	1.7	1.7	1.00
S	BROWN	3	2	3	4	3	2	2.8	2.8	1.00
–	NORTHWEST	2	1	1	2	2	1	1.5	1.5	1.00
	TAP WATER		7				9	8.0	8.0	1.00
	POT. INFL	1	2	0	1	2	0	1.5	1.0	.67
	POT. EFFL	0	1	0	0	1	0	1.0	.3	.33

125 BROMOFORM

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVCCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	0	0	0	0	0	.0	.0	.00
C	WABASH	0	0	0	0	0	0	.0	.0	.00
E	FROST	0	0	0	0	0	0	.0	.0	.00
S	BROWN	0	0	0	0	0	0	.0	.0	.00
–	NORTHWEST	0	0	0	0	0	0	.0	.0	.00
	TAP WATER		0				3	3.0	1.5	.50
	POT. INFL	0	0	0	0	0	0	.0	.0	.00
	POT. EFFL	0	0	0	0	0	0	.0	.0	.00

127 1,1,2,2-TETRACHLORDETHYLEN

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	3	6	77	9	8	21	20.7	20.7	1.00
O	AVOCADO	10	16	11	17	6	27	14.5	14.5	1.00
U	CROSS KEYS	19	69	21	100	38	28	45.8	45.8	1.00
R	BRIGHTWELL	26	19	12	14	14	11	16.0	16.0	1.00
C	WABASH	31	7	7	15	7	22	14.8	14.8	1.00
E	FROST	8	11	19	14	32	18	17.0	17.0	1.00
S	BROWN	16	3	2	2	74	5	17.0	17.0	1.00
-	NORTHWEST	10	7	6	17	59	23	20.3	20.3	1.00
	TAP WATER		2				1	1.5	1.5	1.00
	POTW INFL	40	41	51	70	32	36	45.0	45.0	1.00
	POTW EFFL	14	10	13	14	7	0	11.6	9.7	.83

128 TOLUENE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	3	4	2	2	1	1	2.2	2.2	1.00
O	AVOCADO	5	18	3	6	3	3	6.3	6.3	1.00
U	CROSS KEYS	6	6	5	7	6	6	6.0	6.0	1.00
R	BRIGHTWELL	5	6	38	12	8	1	11.7	11.7	1.00
C	WABASH	6	5	4	18	4	5	7.0	7.0	1.00
E	FROST	5	4	4	14	3	3	5.5	5.5	1.00
S	BROWN	5	4	4	9	25	200	41.2	41.2	1.00
-	NORTHWEST	19	29	44	25	19	13	24.8	24.8	1.00
	TAP WATER		2				0	2.0	1.0	.50
	POTW INFL	41	65	83	73	57	43	60.3	60.3	1.00
	POTW EFFL	1	2	4	0	0	2	2.3	1.5	.67

129 CHLOROBENZENE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVOCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	1	0	1	0	0	0	1.0	.3	.33
C	WABASH	0	0	0	0	0	1	1.0	.2	.17
E	FROST	0	0	0	0	0	0	.0	.0	.00
S	BROWN	0	0	0	0	0	0	.0	.0	.00
-	NORTHWEST	1	0	0	0	0	1	1.0	.3	.33
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	0	0	0	0	1	1.0	.2	.17
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

130 ETHYL BENZENE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVCCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	0	0	0	0	1	0	1.0	.2	.17
R	BRIGHTWELL	0	1	15	4	0	0	6.7	3.3	.50
C	WABASH	0	0	0	0	0	1	1.0	.2	.17
E	FROST	0	0	2	0	0	1	1.5	.5	.33
S	BROWN	4	2	1	0	2	4	2.6	2.2	.83
–	NORTHWEST	3	4	5	4	3	3	3.7	3.7	1.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	12	20	17	17	16	12	15.7	15.7	1.00
	POTW EFFL	0	0	0	6	0	0	6.0	1.0	.17

201 2-CHLOROPHENOL

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVCCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	0	0	0	0	0	.0	.0	.00
C	WABASH	0	0	0	0	0	0	.0	.0	.00
E	FROST	0	0	0	0	0	0	.0	.0	.00
S	BROWN	0	0	0	0	15	0	15.0	2.5	.17
–	NORTHWEST	0	0	0	0	0	0	.0	.0	.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	0	0	0	0	0	.0	.0	.00
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

203 PHENOL

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	11	0	11.0	1.8	.17
O	AVCCADO	11	11	14	13	11	28	14.7	14.7	1.00
U	CROSS KEYS	10	0	16	10	0	0	12.0	6.0	.50
R	BRIGHTWELL	0	12	0	15	0	13	13.3	6.7	.50
C	WABASH	14	24	21	19	17	44	23.2	23.2	1.00
E	FROST	0	0	11	16	0	17	14.7	7.3	.50
S	BROWN	0	0	0	0	0	0	.0	.0	.00
–	NORTHWEST	0	0	15	12	0	0	13.5	4.5	.33
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	19	12	17	16	0	16.0	10.7	.67
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

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204 2.4-DIMETHYLPHENOL
                                                                                AVERAGE                FRACTION
SITES                                                                            WHEN                  PRESENT
                  TUES       WED      THURS       FRI       SAT       SUN    PRESENT  AVERAGE    PRESENT
S EPPINGHAM          0         0          0         0         0         0        .0       .0        .00
O AVCCADO            0         0          0         0         0        11      11.0      1.8        .17
U CROSS KEYS         0         0          0         0         0         0        .0       .0        .00
R BRIGHTWELL         0         0          0         0         0         0        .0       .0        .00
C WABASH             0         0          0         0         0         0        .0       .0        .00
E FRCST              0         0          0         0         0         0        .0       .0        .00
S BRCWN              0         0          0         0         0         0        .0       .0        .00
  NORTHWEST          0         0          0         0         0         0        .0       .0        .00
- TAP WATER                    0                                        0        .0       .0        .00
  POTW INFL          0         0          0         0         0         0        .0       .0        .00
  POTW EFFL          0         0          0         0         0         0        .0       .0        .00

205 2.4-DICHLOROPHENOL
                                                                                AVERAGE                FRACTION
SITES                                                                            WHEN                  PRESENT
                  TUES       WED      THURS       FRI       SAT       SUN    PRESENT  AVERAGE    PRESENT
S EPPINGHAM          0         0          0         0         0         0        .0       .0        .00
O AVCCADO            0         0          0         0         0         0        .0       .0        .00
U CROSS KEYS         0         0          0         0         0         0        .0       .0        .00
R BRIGHTWELL         0         0          0         0         0         0        .0       .0        .00
C WABASH             0         0          0         0         0         0        .0       .0        .00
E FROST              0         0          0         0        15         0      15.0      2.5        .17
S BRCWN              0         0          0         0         0         0        .0       .0        .00
  NORTHWEST          0         0          0         0         0         0        .0       .0        .00
- TAP WATER                    0                                        0        .0       .0        .00
  POTW INFL          0         0          0         0         0         0        .0       .0        .00
  POTW EFFL          0         0          0         0         0         0        .0       .0        .00

206 2.4.6-TRICHLOROPHENOL
                                                                                AVERAGE                FRACTION
SITES                                                                            WHEN                  PRESENT
                  TUES       WED      THURS       FRI       SAT       SUN    PRESENT  AVERAGE    PRESENT
S EPPINGHAM          0         0          0         0         0         0        .0       .0        .00
O AVCCADO            0         0          0         0         0         0        .0       .0        .00
U CROSS KEYS         0         0          0         0         0         0        .0       .0        .00
R BRIGHTWELL         0         0          0         0         0         0        .0       .0        .00
C WABASH             0         0          0         0         0         0        .0       .0        .00
E FROST              0         0          0         0        12         0      12.0      2.0        .17
S BROWN              0         0          0         0         0         0        .0       .0        .00
  NORTHWEST          0         0          0         0         0         0        .0       .0        .00
- TAP WATER                    0                                        0        .0       .0        .00
  POTW INFL          0         0          0         0         0         0        .0       .0        .00
  POTW EFFL          0         0          0         0         0         0        .0       .0        .00
```

301 DICHLOROBENZENES

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVOCADO	30	0	0	49	0	0	39.5	13.2	.33
U	CROSS KEYS	31	32	34	30	30	0	31.4	26.2	.83
R	BRIGHTWELL	32	35	0	31	0	31	32.3	21.5	.67
C	WABASH	33	32	33	34	30	30	32.0	32.0	1.00
E	FROST	32	36	35	32	31	0	33.2	27.7	.83
S	BROWN	36	33	31	0	0	0	33.3	16.7	.50
-	NORTHWEST	0	42	34	30	34	0	35.0	23.3	.67
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	31	34	31	0	30	30	31.2	26.0	.83
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

315 NAPHTHALENE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVOCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	14	94	0	0	0	54.0	18.0	.33
C	WABASH	0	0	0	0	0	0	.0	.0	.00
E	FROST	12	0	12	33	0	0	19.0	9.5	.50
S	BROWN	23	13	14	12	0	0	15.5	10.3	.67
-	NORTHWEST	0	0	13	0	0	13	13.0	4.3	.33
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	10	23	13	13	0	0	14.8	9.8	.67
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

326 DIETHYL PHTHALATE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	19	21	21	19	0	0	20.0	13.3	.67
O	AVOCADO	10	25	11	11	0	14	14.2	11.8	.83
U	CROSS KEYS	0	18	30	14	0	11	18.3	12.2	.67
R	BRIGHTWELL	0	0	0	11	0	11	11.0	3.7	.33
C	WABASH	0	0	11	0	0	0	11.0	1.8	.17
E	FROST	0	0	0	0	0	0	.0	.0	.00
S	BROWN	0	0	0	0	0	0	.0	.0	.00
-	NORTHWEST	17	0	17	0	0	0	17.0	5.7	.33
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	0	13	12	0	17	14.0	7.0	.50
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

331 ANTHRACENE/PHENANTHRENE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVOCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	0	107	0	0	0	107.0	17.8	.17
C	WABASH	0	0	0	0	0	0	.0	.0	.00
E	FROST	0	0	0	0	0	0	.0	.0	.00
S	BROWN	0	0	0	0	0	0	.0	.0	.00
–	NORTHWEST	0	0	0	0	0	0	.0	.0	.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	0	0	0	0	0	.0	.0	.00
	POTW EFFL	0	0	0	13	0	0	13.0	2.2	.17

333 DI-N-BUTYL PHTHALATE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	40	12	0	0	0	26.0	8.7	.33
O	AVOCADO	0	26	14	0	0	91	43.7	21.8	.50
U	CROSS KEYS	0	15	14	0	0	0	14.5	4.8	.33
R	BRIGHTWELL	0	12	0	14	17	0	14.3	7.2	.50
C	WABASH	0	14	12	0	11	0	12.3	6.2	.50
E	FROST	13	230	200	36	0	0	119.8	79.8	.67
S	BROWN	140	87	280	55	0	0	140.5	93.7	.67
–	NORTHWEST	82	0	20	0	0	0	51.0	17.0	.33
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	12	26	21	12	13	11	15.8	15.8	1.00
	POTW EFFL	0	0	13	0	0	0	13.0	2.2	.17

335 PYRENE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVOCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	0	9	0	0	0	9.0	1.5	.17
C	WABASH	0	0	0	0	0	0	.0	.0	.00
E	FROST	0	0	0	0	0	0	.0	.0	.00
S	BROWN	0	0	0	0	0	0	.0	.0	.00
–	NORTHWEST	0	0	0	0	0	0	.0	.0	.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	0	0	0	0	0	.0	.0	.00
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

337 BUTYL BENZYL PHTHALATE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	12	12	13	15	13	14	13.2	13.2	1.00
O	AVCCADO	13	15	14	14	0	14	14.0	11.7	.83
U	CROSS KEYS	24	13	16	13	13	18	16.2	16.2	1.00
R	BRIGHTWELL	15	23	48	15	26	17	24.0	24.0	1.00
C	WABASH	12	11	13	10	0	12	11.6	9.7	.83
E	FROST	11	53	26	0	0	14	26.0	17.3	.67
S	BROWN	0	0	0	0	0	10	10.0	1.7	.17
-	NORTHWEST	27	14	14	12	0	15	16.4	13.7	.83
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	14	13	16	11	14	0	13.6	11.3	.83
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

338 BIS(2-ETHYLHEXYL)PHTHALATE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	16	0	0	0	16.0	2.7	.17
O	AVCCADO	0	0	0	0	0	0	.0	.0	.00
U	CRCSS KEYS	14	0	12	0	0	0	13.0	4.3	.33
R	BRIGHTWELL	240	14	34	0	0	0	96.0	48.0	.50
C	WABASH	0	0	0	0	0	11	11.0	1.8	.17
E	FROST	0	0	0	0	0	0	.0	.0	.00
S	BROWN	0	0	0	0	0	0	.0	.0	.00
-	NORTHWEST	27	0	0	0	0	0	27.0	4.5	.17
	TAF WATER		0				0	.0	.0	.00
	POTW INFL	0	0	13	0	13	0	13.0	4.3	.33
	PUTW EFFL	0	0	0	0	0	0	.0	.0	.00

501 ANTIMCNY

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	10	9	24	11	12	8	12.3	12.3	1.00
O	AVOCADO	7	18	11	23	5	9	12.2	12.2	1.00
U	CROSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	0	0	0	0	0	.0	.0	.00
C	WABASH	0	0	0	0	0	0	.0	.0	.00
E	FROST	9	9	10	10	8	7	8.8	8.8	1.00
S	BROWN	0	0	0	0	0	0	.0	.0	.00
-	NORTHWEST	0	0	0	0	0	0	.0	.0	.00
	TAP WATER		12				12	12.0	12.0	1.00
	PUTW INFL	7	51	200	32	11	14	52.5	52.5	1.00
	POTW EFFL	17	30	23	19	15	35	23.2	23.2	1.00

502 ARSENIC

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVCCADO	0	0	0	0	0	0	.0	.0	.00
U	CRCSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	0	0	0	0	0	.0	.0	.00
C	WABASH	0	0	0	0	0	0	.0	.0	.00
E	FHOST	0	0	0	0	0	0	.0	.0	.00
S	BROWN	5	7	11	5	5	0	6.6	5.5	.83
-	NORTHWEST	0	0	0	0	0	0	.0	.0	.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	0	0	0	0	0	.0	.0	.00
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

504 CADMIUM

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	8	0	0	8.0	1.3	.17
O	AVCCADO	0	0	0	5	0	0	5.0	.8	.17
U	CRGSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	4	31	0	0	0	17.5	5.8	.33
C	WABASH	0	0	0	6	9	4	6.3	3.2	.50
E	FROST	0	0	14	31	21	0	22.0	11.0	.50
S	BROWN	0	0	0	0	30	0	30.0	5.0	.17
-	NORTHWEST	0	0	0	0	0	0	.0	.0	.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	2	2	8	6	0	4.5	3.0	.67
	POTW EFFL	0	5	0	0	0	0	5.0	.8	.17

505 CHROMIUM

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	6	6	5	32	7	6	10.3	10.3	1.00
O	AVOCADO	8	6	6	10	10	6	7.7	7.7	1.00
U	CROSS KEYS	8	6	6	4	9	8	6.8	6.8	1.00
R	BRIGHTWELL	6	11	9	8	10	17	10.2	10.2	1.00
C	WABASH	44	24	46	35	29	12	31.7	31.7	1.00
E	FRCST	22	660	36	22	48	17	134.2	134.2	1.00
S	BROWN	29	33	14	12	12	9	18.2	18.2	1.00
-	NORTHWEST	100	8	7	0	8	9	26.4	22.0	.83
	TAP WATEH		0				0	.0	.0	.00
	POTW INFL	125	150	180	140	160	58	135.5	135.5	1.00
	POTW EFFL	58	58	61	70	76	41	60.7	60.7	1.00

506 COPPER

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	30	30	33	32	30	30	30.8	30.8	1.00
O	AVOCADO	38	36	34	37	33	36	35.7	35.7	1.00
U	CROSS KEYS	40	37	34	40	51	48	41.7	41.7	1.00
R	BRIGHTWELL	64	200	75	49	350	33	131.8	131.8	1.00
C	WABASH	31	69	100	35	40	36	51.8	51.8	1.00
E	FROST	34	220	57	42	34	36	70.5	70.5	1.00
S	BROWN	36	37	64	43	31	32	40.5	40.5	1.00
-	NORTHWEST	37	30	46	28	27	27	32.5	32.5	1.00
	TAP WATER		7				6	6.5	6.5	1.00
	POTW INFL	38	53	43	59	48	39	46.7	46.7	1.00
	POTW EFFL	10	10	21	18	7	15	13.5	13.5	1.00

507 LEAD

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	52	52	52	50	73	50	54.8	54.8	1.00
O	AVOCADO	51	56	54	59	53	53	54.3	54.3	1.00
U	CROSS KEYS	110	69	64	61	170	53	87.8	87.8	1.00
R	BRIGHTWELL	490	2200	420	210	1200	89	768.2	768.2	1.00
C	WABASH	66	190	61	64	68	60	84.8	84.8	1.00
E	FROST	76	170	86	80	92	71	95.8	95.8	1.00
S	BROWN	54	65	150	60	86	60	79.2	79.2	1.00
-	NORTHWEST	74	120	100	82	71	84	88.5	88.5	1.00
	TAP WATER		30				27	28.5	28.5	1.00
	POTW INFL	220	220	250	310	160	100	210.0	210.0	1.00
	POTW EFFL	64	64	60	59	58	56	60.2	60.2	1.00

508 MANGANESE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	160	170	230	250	170	210	198.3	198.3	1.00
O	AVOCADO	200	230	240	200	230	210	218.3	218.3	1.00
U	CROSS KEYS	98	84	92	74	120	82	91.7	91.7	1.00
R	BRIGHTWELL	100	110	120	90	100	120	106.7	106.7	1.00
C	WABASH	210	220	200	220	180	180	201.7	201.7	1.00
E	FROST	200	180	200	210	220	220	205.0	205.0	1.00
S	BROWN	77	63	47	51	71	60	61.5	61.5	1.00
-	NORTHWEST	260	270	260	270	250	300	268.3	268.3	1.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	200	200	200	200	210	200	201.7	201.7	1.00
	POTW EFFL	180	170	160	160	150	42	143.7	143.7	1.00

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509 MERCURY
                                                                            AVERAGE
SITES                                                                         WHEN              FRACTION
                  TUES        WED      THURS        FRI        SAT        SUN  PRESENT  AVERAGE   PRESENT
S EPPINGHAM          0          0          0          3          0          0      3.0       .5       .17
O AVCCADO            0          3          0          5          5          0      4.3      2.2       .50
U CROSS KEYS         0          0          0          4          0          0      4.0       .7       .17
R BRIGHTWELL         0          3          0          3          0          0      3.0      1.0       .33
C WABASH             0          0          0          0          0          0       .0       .0       .00
E FROST              0          0          0          0          0          0       .0       .0       .00
S BROWN              0          0          0          0          0          0       .0       .0       .00
- NORTHWEST          3          0          0          0          0          0      3.0       .5       .17
  TAP WATER                     0                                           0       .0       .0       .00
  POTW INFL          0          3          0          0          0          0      3.0       .5       .17
  POTW EFFL          0          0          0          0          0          0       .0       .0       .00

510 NICKEL
                                                                            AVERAGE
SITES                                                                         WHEN              FRACTION
                  TUES        WED      THURS        FRI        SAT        SUN  PRESENT  AVERAGE   PRESENT
S EPPINGHAM          8          8          8         21          7          6      9.7      9.7      1.00
O AVCCADO           11          6          8          8          9          7      8.2      8.2      1.00
U CROSS KEYS        11          6          5          5         13          7      7.8      7.8      1.00
R BRIGHTWELL         8         11         12          8         10         11     10.0     10.0      1.00
C WABASH             8          7          8          8          9         13      8.8      8.8      1.00
E FROST              7         19         10          9          9          8     10.3     10.3      1.00
S BROWN              7          6          4          6          6          6      5.8      5.8      1.00
- NORTHWEST         10          7          7          6          8          7      7.5      7.5      1.00
  TAP WATER                     0                                           0       .0       .0       .00
  POTW INFL         52         60         65         57         29         11     45.7     45.7      1.00
  POTW EFFL         33         35         42         42         31         15     33.0     33.0      1.00

511 SELENIUM
                                                                            AVERAGE
SITES                                                                         WHEN              FRACTION
                  TUES        WED      THURS        FRI        SAT        SUN  PRESENT  AVERAGE   PRESENT
S EPPINGHAM          8          8          9          7          7          8      7.8      7.8      1.00
O AVCCADO           15         15         13         14         20          8     14.2     14.2      1.00
U CROSS KEYS        17         18         17         18         23         16     18.2     18.2      1.00
R BRIGHTWELL        10         10          9          9          8          7      8.8      8.8      1.00
C WABASH            13         13         11          7         14          7     10.8     10.8      1.00
E FROST              7          0          0         12          0          0      9.5      3.2       .33
S BROWN              0          0          0          0          0          4      4.0       .7       .17
- NORTHWEST          0          0          0          4          0          0      4.0       .7       .17
  TAP WATER                     8                                           8      8.0      8.0      1.00
  POTW INFL         21          0          0          0          4          0     12.5      4.2       .33
  POTW EFFL          9          0          7          8          6          6      7.2      6.0       .83
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512 SILVER

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	8	0	0	0	18	0	13.0	4.3	.33
O	AVCCADO	0	0	0	0	50	20	35.0	11.7	.33
U	CROSS KEYS	0	7	0	0	0	0	7.0	1.2	.17
R	BRIGHTWELL	0	0	0	0	0	4	4.0	.7	.17
C	WABASH	0	0	0	0	4	0	4.0	.7	.17
E	FROST	0	6	0	4	7	0	5.7	2.8	.50
S	BROWN	91	740	230	690	1100	600	575.2	575.2	1.00
-	NORTHWEST	0	7	0	10	4	0	7.0	3.5	.50
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	18	17	16	19	12	14	16.0	16.0	1.00
	POTW EFFL	5	7	33	18	7	0	14.0	11.7	.83

513 THALLIUM

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	0	0	0	0	0	0	.0	.0	.00
O	AVCCADO	0	0	0	0	0	0	.0	.0	.00
U	CROSS KEYS	0	0	0	0	0	0	.0	.0	.00
R	BRIGHTWELL	0	0	0	0	0	0	.0	.0	.00
C	WABASH	0	0	0	0	2	0	2.0	.3	.17
E	FROST	0	0	0	2	0	0	2.0	.3	.17
S	BROWN	0	0	0	0	0	0	.0	.0	.00
-	NORTHWEST	0	0	0	0	0	0	.0	.0	.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	0	0	0	0	0	0	.0	.0	.00
	POTW EFFL	0	0	0	0	0	0	.0	.0	.00

514 ZINC

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EPPINGHAM	85	170	86	89	120	63	102.2	102.2	1.00
O	AVOCADO	110	93	78	120	120	76	99.5	99.5	1.00
U	CROSS KEYS	120	76	66	74	270	91	116.2	116.2	1.00
R	BRIGHTWELL	140	440	200	230	5400	100	1085.0	1085.0	1.00
C	WABASH	1900	1300	1500	2000	880	210	1298.3	1298.3	1.00
E	FROST	840	710	900	800	450	220	653.3	653.3	1.00
S	BROWN	140	91	140	150	110	66	116.2	116.2	1.00
-	NORTHWEST	91	80	85	71	66	64	76.2	76.2	1.00
	TAP WATER		29				0	29.0	14.5	.50
	POTW INFL	290	330	420	310	250	140	290.0	290.0	1.00
	POTW EFFL	86	120	110	95	97	67	95.8	95.8	1.00

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601 TOTAL CYANIDES
                                                                              AVERAGE
SITES                                                                          WHEN              FRACTION
                 TUES      WED     THURS       FRI       SAT       SUN      PRESENT  AVERAGE   PRESENT
S EPPINGHAM         0        0         0         0         0         0          .0       .0       .00
O AVCCADO           0        0         0         0         0         0          .0       .0       .00
U CROSS KEYS        0        0         0         0         0         0          .0       .0       .00
R BRIGHTWELL        0        0        11         0         0         0        11.0      1.8       .17
C WABASH           34       88        38        62        32        56        51.7     51.7      1.00
E FROST            29       80        20       132        66        18        57.5     57.5      1.00
S BROWN             0        0        10         0         0         0        10.0      1.7       .17
_ NORTHWEST         0        0         0         0        10         0        10.0      1.7       .17
  TAP WATER                  0                                       0          .0       .0       .00
  POTW INFL        12       21        22        22         0        10        17.4     14.5       .83
  POTW EFFL         0        0         0         0         0         0          .0       .0       .00

602 TOTAL PHENOLS
                                                                              AVERAGE
SITES                                                                          WHEN              FRACTION
                 TUES      WED     THURS       FRI       SAT       SUN      PRESENT  AVERAGE   PRESENT
S EPPINGHAM        20       28        16        34        24       101        37.2     37.2      1.00
O AVOCADO          10       28        48        39        53        48        37.7     37.7      1.00
U CROSS KEYS        0       21        62        37        47        27        38.8     32.3       .83
R BRIGHTWELL       31       24        47        51        41        30        37.3     37.3      1.00
C WABASH           20       34        38        51        58        56        42.8     42.8      1.00
E FROST            26       26        46        33        14        26        28.5     28.5      1.00
S BROWN            24       44        30        10        36        23        27.8     27.8      1.00
_ NORTHWEST        12       42        36        35        42        18        30.8     30.8      1.00
  TAP WATER                  0                                       0          .0       .0       .00
  POTW INFL        58       55        80        75        63        34        60.8     60.8      1.00
  POTW EFFL         0        0        20        11        11        12        13.5      9.0       .67

701 PH
                                                                              AVERAGE
SITES                                                                          WHEN              FRACTION
                 TUES      WED     THURS       FRI       SAT       SUN      PRESENT  AVERAGE   PRESENT
S EPPINGHAM         7        7         7         7         7         7         7.0      7.0      1.00
O AVOCADO           6        7         7         7         7         7         7.0      7.0      1.00
U CROSS KEYS        7        7         7         7         7         7         7.0      7.0      1.00
R BRIGHTWELL        7        7         7         8         7         7         7.1      7.1      1.00
C WABASH            7        7         8         7         8         7         7.2      7.2      1.00
E FROST             7        8         7         7         9         7         7.6      7.6      1.00
S BROWN             7        8         8         7         8         7         7.6      7.6      1.00
_ NORTHWEST         7        7         7         7         7         7         7.0      7.0      1.00
  TAP WATER                  9                                       8         8.1      8.1      1.00
  POTW INFL         7        7         7         7         7         7         7.0      7.0      1.00
  POTW EFFL         7        7         7         7         7         7         7.0      7.0      1.00
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702 T( C)
                                                                                 AVERAGE
SITES                                                                              WHEN              FRACTION
                  TUES        WED      THURS        FRI        SAT        SUN   PRESENT   AVERAGE    PRESENT
S EPPINGHAM         19         18         17         16         16         15      17.0      17.0       1.00
O AVOCADO           19         19         18         17         16         15      17.1      17.1       1.00
U CROSS KEYS        20         20         19         17         16         16      18.0      18.0       1.00
R BRIGHTWELL        19         19         17         16         15         17      16.8      16.8       1.00
C WABASH            16         15         15         16         17         15      15.7      15.7       1.00
E FROST             15         16         15         16         17         15      15.8      15.8       1.00
S BROWN             15         14         15         16         17         13      14.9      14.9       1.00
- NORTHWEST         17         17         17         17         19         16      17.0      17.0       1.00
  TAP WATER                    21                                          20      20.3      20.3       1.00
  POTW INFL         18         19         19         19         19         19      18.6      18.6       1.00
  POTW EFFL         17         17         17         18         18         17      17.4      17.4       1.00
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703 AMMONIA
                                                                                 AVERAGE
SITES                                                                              WHEN              FRACTION
                  TUES        WED      THURS        FRI        SAT        SUN   PRESENT   AVERAGE    PRESENT
S EPPINGHAM         14         17         17         18         18         12      16.0      16.0       1.00
O AVOCADO           24         21         20         22         23         19      21.5      21.5       1.00
U CROSS KEYS         8          9         10         10          8          4       8.2       8.2       1.00
R BRIGHTWELL        16         19         19         17         14         15      16.7      16.7       1.00
C WABASH            10         12         11         15         12         11      11.8      11.8       1.00
E FROST             12          8         12         14          9         10      10.8      10.8       1.00
S BROWN             20         26         20         17         23         24      21.7      21.7       1.00
- NORTHWEST          9         10         11         11         12          7      10.0      10.0       1.00
  TAP WATER                     1                                           0        .4        .4       1.00
  POTW INFL         16         16         17         21         16         16      17.0      17.0       1.00
  POTW EFFL         15         15         14         16         17         16      15.5      15.5       1.00
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704 OIL AND GREASE
                                                                                 AVERAGE
SITES                                                                              WHEN              FRACTION
                  TUES        WED      THURS        FRI        SAT        SUN   PRESENT   AVERAGE    PRESENT
S EPPINGHAM         25         35         40         35         30         90      42.5      42.5       1.00
O AVOCADO           45         80         45         30         30        100      55.0      55.0       1.00
U CROSS KEYS        30        100         20         60         40         45      49.2      49.2       1.00
R BRIGHTWELL        35         85       2500         30         60         40     458.3     458.3       1.00
C WABASH            25         25         25         30         40         50      32.5      32.5       1.00
E FROST             40         20         20         20         30          0      26.0      21.7        .83
S BROWN              0         15         10          0         10          0      11.7       5.8        .50
- NORTHWEST         30         40         70         20         60         30      41.7      41.7       1.00
  TAP WATER                     0                                           0        .0        .0        .00
  POTW INFL         50         20         35         40         20         20      30.8      30.8       1.00
  POTW EFFL          0          0          5          0          0          0       5.0        .8        .17
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705 TSS

SITES                                                                     AVERAGE
                                                                            WHEN                FRACTION
                    TUES      WED     THURS      FRI      SAT      SUN    PRESENT   AVERAGE    PRESENT
S EPPINGHAM           40       80        80      140      150      110      100.0     100.0       1.00
O AVOCADO            160       90       170       60      190      130      133.3     133.3       1.00
U CROSS KEYS         140       80        90       70       70      220      111.7     111.7       1.00
R BRIGHTWELL          80      180       210      120      170      110      145.0     145.0       1.00
C WABASH              70       70        60       80      110       70       76.7      76.7       1.00
E FROST               60      100       100       50      140      130       96.7      96.7       1.00
S BROWN               50       60        40       70       20       20       43.3      43.3       1.00
- NORTHWEST           80      110        60      100      110       50       85.0      85.0       1.00
  TAP WATER                     0                                    0         .0        .0        .00
  POTW INFL          100      100       160      140      130      120      125.0     125.0       1.00
  POTW EFFL           25       20        10       15       20       20       18.3      18.3       1.00

706 TOC

SITES                                                                     AVERAGE
                                                                            WHEN                FRACTION
                    TUES      WED     THURS      FRI      SAT      SUN    PRESENT   AVERAGE   *PRESENT
S EPPINGHAM           54       66        74       94      140      105       88.8      88.8       1.00
O AVOCADO             96      108       140       80      125      175      120.7     120.7       1.00
U CROSS KEYS          96      100        80       82       76      110       90.7      90.7       1.00
R BRIGHTWELL          70      104       160       92      105      120      108.5     108.5       1.00
C WABASH              64       88        66       86       86       82       78.7      78.7       1.00
E FROST               56       88        76       74       94       92       80.0      80.0       1.00
S BROWN               34       52        42       42       28       20       36.3      36.3       1.00
- NORTHWEST           74      140        92      135      110      110      110.2     110.2       1.00
  TAP WATER                     8                                    8        8.0       8.0       1.00
  POTW INFL           82      100        94      105       98      105       97.3      97.3       1.00
  POTW EFFL           23       44        21       28       19       22       26.2      26.2       1.00

707 COD

SITES                                                                     AVERAGE
                                                                            WHEN                FRACTION
                    TUES      WED     THURS      FRI      SAT      SUN    PRESENT   AVERAGE    PRESENT
S EPPINGHAM          125      180       155      280      190      235      194.2     194.2       1.00
O AVOCADO            370      400       305      175      270      315      305.8     305.8       1.00
U CROSS KEYS         360      370       185      170      125      185      232.5     232.5       1.00
R BRIGHTWELL         205      330       550      285      280      190      306.7     306.7       1.00
C WABASH             225      310       230      135      195      160      209.2     209.2       1.00
E FROST              155      290       180      115      230      180      191.7     191.7       1.00
S BROWN              150      190       135      115      160      130      146.7     146.7       1.00
- NORTHWEST          160      380       160      295      210      100      220.8     220.8       1.00
  TAP WATER                     0                                    0         .0        .0        .00
  POTW INFL          200      410       430      285      255      255      305.8     305.8       1.00
  POTW EFFL           45       80        50       75       80       80       68.3      68.3       1.00
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708 BOD

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S	EFFINGHAM	55	85	100	115	150	190	115.8	115.8	1.00
O	AVOCADO	155	135	230	100	225	220	177.5	177.5	1.00
U	CROSS KEYS	165	120	100	150	140	180	142.5	142.5	1.00
R	BRIGHTWELL	90	115	325	110	155	140	155.8	155.8	1.00
C	WABASH	50	100	80	115	135	115	99.2	99.2	1.00
E	FROST	65	75	90	90	0	100	84.0	70.0	.83
S	BROWN	40	40	60	65	30	30	44.2	44.2	1.00
-	NORTHWEST	145	245	120	270	220	130	188.3	188.3	1.00
	TAP WATER		0				0	.0	.0	.00
	POTW INFL	125	140	165	170	150	180	155.0	155.0	1.00
	POTW EFFL	20	20	15	15	15	25	18.3	18.3	1.00